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CONTENTS.

PAGE

Eccentric Rod Construction. By C. O. Griffin 939
Bevel Gear Curves. By H. W. Alden. 940
De La Vergne Big Boring Mill. By H. L. Arnold..... 942
Machine Shop Oculists..... 944
A Universal Section Liner..... 945
A New Lathe Chuck. By F. A. Halsey 945
Attachment for Grinding Formed Cutters, Reamers, Taps, etc..... 947
An Improved Polishing Frame..... 947
A Shop Incident..... 948
Electrical Machinery: The Snap Limit Switch of the Sprague Electric Elevator....The Ball Nut of the Sprague Electric Elevator....Electrical Tests of Power Required by Metal-Working Machinery at the Navy Yard, Washington, D. C. By Prof. O. G. Dodge, U. S. N....948-949
Letters from Practical Men: Another Good Job Without Tools. By George F. Waddell....A Blueprin Frame . By W. H . Sargent.... Hardening. By F. L. Hubbard.... That Novel Compound Engine. By W. C. Kelly....Power Required to Groove Rolls. By F. Thornely.... Square versus V-Slides on Shapers. By F. C. McClary....Diameter of Ball Bearings. By Arthur B. Babbitt....A Working Test of a Threaded Piston Rod. By J. H. Dunbar....The Late Mr. Holloway's Foundry Management. By Thos. D. West....Centering Both Ends at Once. By Tecumseh Swift ....Screw Propeller Designing. By C. Purcell Taylor, Bart., D. Sc..950-955
Lubricants and Anti-Lubricants..... 955
A New Universal Milling Machine.. 956
Solution of Cubic Equations. By George B. Grant..... 956
The Fair of the American Institute.. 957
Politics and Business..... 958
Getting the Benefit of Our Inventions. 958
Questions and Answers..... 959
Commercial Review..... 959

Index to Articles Advertised, Pages 10 to 13.
Index to Advertisers, Page 9.

POSITION
IS NOT
EVERYTHING.

WHOSEESIT?

DON'T get a notion that size and boldness mean everything in an ad.

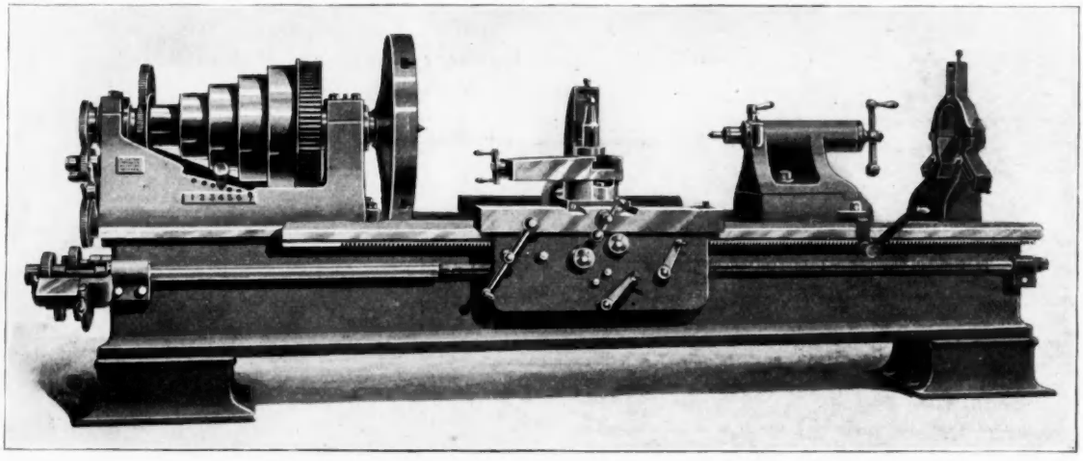
If you had an ad in 40-foot letters from end to end of the Chinese wall, it would be simply tremendous—greatest on earth.

But it wouldn't help sell your goods—that is what ads are for.

Some machinery advertisers don't recognize the value of the best and most conspicuous place in the world for their particular kind of ad—the place where the most machinery buyers see it.

The space is not for sale!—rented at $100 per week.

You are looking at it now.



Some years ago the General Manager of a big railroad was in consultation with the Grief Committee of the Train Men. One of the latter became exasperated and proceeded to take the old man down, "I remember," said he, "when you were a hostler in a livery stable." "So I was," answered the official, *"and I was the best hostler in Chicago."*

There are a great many lathes made in this country, we make many ourselves—this is the best lathe, in every way, that we know how to build. Mechanics who are using it do not hesitate to say that it is the very best lathe made.

This is a business lathe. It is built to do heavy, hard work, and is so constructed as to do it with the least loss of time or effort.

It has many new features, but every part has been re-designed with one end in view—work.

The most work in the least time—that's what we aim for.

Index to Advertisers.

	PAGE
Abbott, Wheelock & Co	9
Acme Machinery Co	14
Adt & Son, John	13
Albro-Clem Elevator Co	37
Almond, T. R	8
American Gas Furnace Co	4
Ames Iron Works	46
Arcade File Works	14
Armstrong Bros. Tool Co	7
Armstrong Mfg. Co	9
Aurora Tool Works	37
Bacon, L. Seward	5
Backus Water Motor Co	46
Baird & Co., Henry Carey	41
Ball-Bearing Co., The	4
Barker & Co., William	8
Barnes Co., W. F. & John	12
Bates, Henry H	41
Baush & Harris Machine Tool Co	47
Besly & Co., Chas. H	41
Bethlehem Foundry and Machine Co	37
Betts Machine Co	39
Bickford Drill and Tool Co	43
Bickford, H	48
Bilgram, Hugo	9
Blaisdell & Co., P	43
Bliss Co., E. W	7
Boston Gear Works	46
Box 62	6
Bradford Mill Co., The	45
Bremer Machine Co., Godfrey J	13
Brown & Sharpe Mfg. Co	48
Buffalo Forge Co	47
Builders Iron Foundry	6
Bullard Machine Tool Co	40
Chicago & Northwestern Railway	45
Cincinnati Milling Machine Co	41
Cleveland Machine Screw Co	40
Cleveland Twist Drill Co	43
Coburn Trolley Track Mfg. Co., The	37
Coffin & Leighton	37
Columbia University	37
Conover Mfg. Co	41
Coshocton Foundry Co	6
Crescent Steel Co	43
Crocker-Wheeler Electric Co	7
Cumberland Iron & Steel Shafting Co	7
Curtis & Curtis	37
Cushman Chuck Co	5
Dallett & Co., Thos. H	6
Davis & Egan Mach. Tool Co	45
Dawson & Goodwin	14
Deane Steam Pump Co	14
Detrick & Harvey Machine Co	47
Diamond Machine Co	41
Dietz, Schumacher & Boye	47
Dixon Crucible Co., Joseph	45
Dwight Slate Machine Co	11
Dyer & Driscoll	39
Elliott Chemical Works	6
Erlandsen, J	13
Evans Friction Cone Co	41
Fay & Co., J. A	5
Fay & Scott	48
Felt & Tarrant Mfg. Co	37
Ferracute Machine Co	37
Fifield Tool Co	48
Fitchburg Machine Works	43
Flather & Co	47
Forbes & Co., W. D	12
Fox Machine Co	46
Frick Co., The	46
Garvin Machine Co., The	8
General Electric Co	5
Goodyear, S. W	6
Gould & Eberhardt	41
Grant Gear Works	9
Gray Co., G. A	14
Hall, Geo	9
Hamilton Machine Tool Co	6
Harrington & King Perforating Co	48
Harrington, Son & Co., E	41
Hartford Steam Boiler and Ins. Co	37
Hayden & Derby Mfg. Co	48
Hendey Machine Co	38
Henley & Co., N. W	37
Hill, Clarke & Co	11
Hoggson & Pettis Mfg. Co	5
Horton & Son Co., E	5
Hurlbut-Rogers Machine Co	47
Hyatt Roller Bearing Co	4
International Correspondence Schools	45
Jenkins Bros	39
Johns Mfg. Co., H. W	47
Jones & Co., B. M	4
Jones & Lamson Machine Co	14 and 48
Kelly & Jones Co., The	40
Keuffel & Esser Co	8
Keystone Engine and Machine Works	46
King Mfg. Co	5
Landis Bros	4
LeCount, Wm. G	5
Lodge & Shipley Machine Tool Co	2 and 4
Long & Allstatter Co	5
Luscomb Machine Co., F. W	14
Machinists' Supply Co	4
Maris Bros	47
McCabe, J. J	8
McFadden Co	9
Mewer Tool Co	8
Miner & Peck Mfg. Co	47
Monighan Machine Works	8
Montgomery & Co	6
Morse Twist Drill & Machine Co	6
Mossberg & Granville Mfg. Co	41
National Chuck Co	5
National Machinery Co	13
National Pipe Bending Co	43
Newark Machine Tool Co	48
New Doty Mfg. Co	45
New Haven Mfg. Co	11
New Process Raw Hide Co	45
Newton Machine Tool Works	40
Nicholson File Co	14
Niles Tool Works Co	14
Niles Tool Works Co., N. Y. Branch	8
Norton Emery Wheel Co	39
Oneida Mfg. Chuck Co	5
Ott, Mergenthaler & Co	8
Otto Gas Engine Works	46
Pancoast Ventilator Co	5
Patterson, Gottfried & Hunter	13
Penberthy Injector Co	8
Philadelphia Book Co	4
Pierce Engine Co	46
Pratt & Whitney Co	39
Pratt Chuck Co	5
Prentiss Tool & Supply Co	40
Prouty Co., The	46
Pryibil, P	13
Q. and C. Co	40
Rand Drill Co	43
Reece, Edw. J	8
Reed Co., F. E	41
Roots, P. H. & F. M	47
Saunders' Sons, D	6
Sawyer Tool Co	8
Sebastian Lathe Co	39
Sellers & Co., Inc., Wm	14
Seneca Falls Mfg. Co	39
Shriver & Co., T	43
Sibley & Ware	6
Skinner Chuck Co	5
Slocomb & Co., J. T	11
Smith, E. G	11
Springfield Gas Engine Co., The	46
Standard Tool Co	4
Stark, John	43
Stiles & Fladd Press Co., The	7
Sterling Emery Wheel Mfg. Co	43
Stover Novelty Works	8
Strelinger & Co., Chas. A	12
Sturtevant Co., B. F	47
Stuart's Foundry & Machine Works, R. J	48
Taunton Locomotive Mfg. Co	43
Timolat, J. G	4
Toledo Machine & Tool Co	4
Toomey, Frank	8
Torrington Mfg. Co	6
Trenton Iron Co	7
Trump Bros. Machine Co	37
Warner & Swasey	48
Waterbury-Farrel F'dry & Mach. Co	47
Waterbury Machine Co., The	7
Watson-Stillman Co., The	10
Webster Mfg. Co	37
Webster & Perks Tool Co	41
Wedderburn & Co., John	48
Wells Bros. & Co	4
Weston Engine Co	46
Whiton Machine Co., D. E	5
Wiley & Sons, John	39
Wiley & Russell Mfg. Co	39
Wilkinson & Co., A. J	4
Wilkinson Co., The	5
Wilson, W. A	43
Wilson Laundry Machinery Co	4
Wolverine Motor Works	46
Worcester Machine Screw Co	47
Wyke & Co., J	12
Wyman & Gordon	48

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Sealed Proposals for furnishing the materials and performing the labor required for the installation of engines and other work to be done in the Electric Light Station of the St. Lawrence State Hospital at Point Airy, near Ogdensburg, N. Y., may be sent by mail or delivered in person up to twelve o'clock noon, Friday, October 9, 1896, to George Hall, President of the Board of Managers of the St. Lawrence State Hospital, Ogdensburg, N.Y., at which time and place the Board of Managers will receive and open all proposals.

Parties bidding for this work must be persons or firms actually engaged in the manufacture of steam engines and electric light work and able to refer to work of a similar character performed by them elsewhere.

Proposals must be for the whole work and must be accompanied by bonds of two sureties guaranteeing the faithful execution of the offer if accepted.

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McCabe, J. J., New York.
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Hill, Clarke & Co., Boston, Mass.
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Pratt & Whitney Co., Hartford, Conn
Prentiss Tool & Supply Co., New York.
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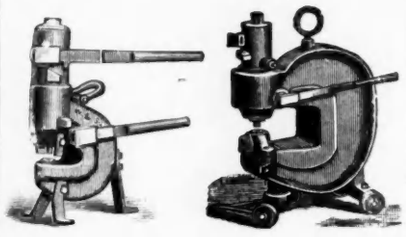

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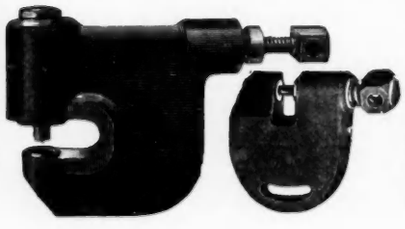

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Sterling Emery Wheel Co., Tiffin, O.
Strelinger & Co., Chas. A., Detroit, Mich

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Prouty Co., The, Chicago, Ill.
Springfield Gas Engine Co., Springfield, O
Webster Manufacturing Co., Chicago, Ill
Wolverine Motor Works, Grand Rapids, Mich.

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Forbes & Co., W. D., Hoboken, N. J.
Frick Co., The, Waynesboro, Pa.
Keystone Engine & Mach. Works, Phila. Pa.
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Weston Engine Co., Painted Post, N. Y

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Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Pratt & Whitney Co., Hartford, Conn
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Whiton Mach. Co., D. E., New London, Conn

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Brown & Sharpe Mfg. Co., Providence, R. I.
Grant Gear Works, Boston, Mass.
New Process Raw Hide Co., Syracuse, N. Y.
Shriver & Co., T., New York.

GRAPHITE.
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GRINDING AND POLISHING MACHINES.
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Brown & Sharpe Mfg. Co., Providence, R. I.
Builders Iron Foundry, Providence, R. I.
Diamond Machine Co., Providence, R. I.
Garvin Machine Co., New York.
Hill, Clarke & Co., Boston, Mass.
Landis Bros., Waynesboro, Pa.
Norton Emery Wheel Co, Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co, Inc., Wm, Philadelphia, Pa.
Strelinger & Co., Chas. A., Detroit, Mich.
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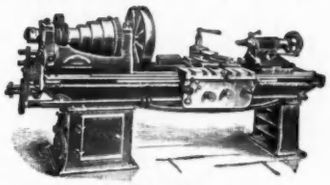

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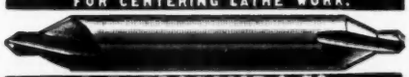

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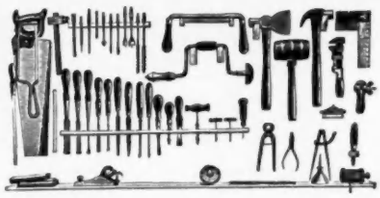

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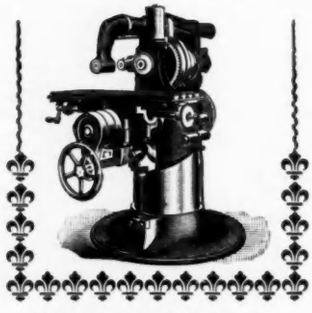

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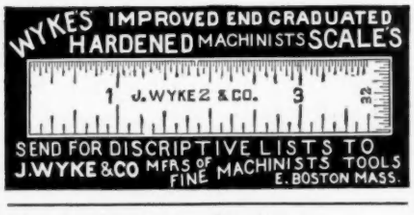
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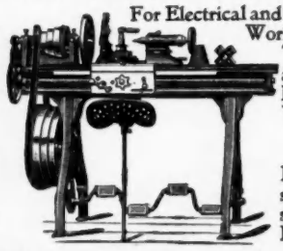

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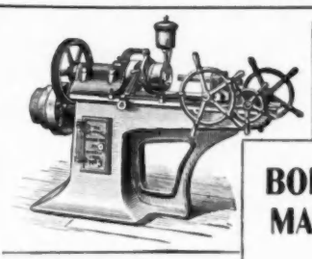

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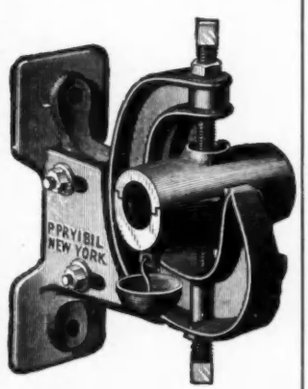

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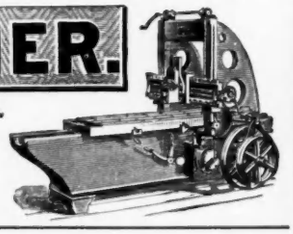

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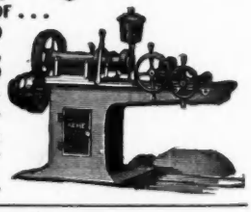

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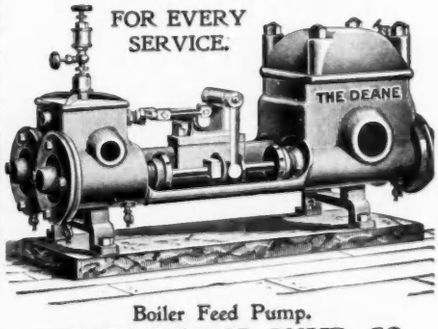

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A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

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Eccentric Rod Construction.

BY C. O. GRIFFIN.

The accompanying sketch shows what is, to the extent of my knowledge and belief, the cheapest construction for eccentric or other similar rods, and at the same time it is entirely satisfactory in service. If there is any objection to it I have never been able to find it.

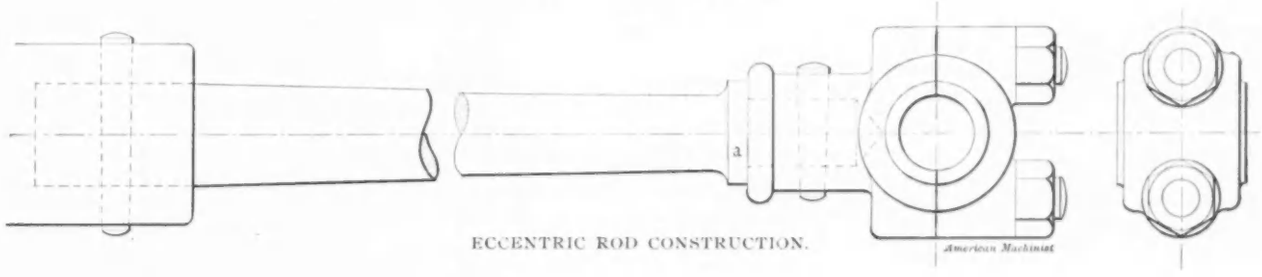
The rod proper is made from round bar stock, without any forge work whatever. At the left-hand end, where it enters the boss on the eccentric strap, it is turned to the largest even size which the stock will hold up to. The shoulder *a* at the right-hand end, is likewise made as large as the bar will allow, and the taper between the two ends provides an appropriate shape. The eye is a simple cast affair in halves, held together with studs and having a socket into which the end of the rod enters. If the designer wants some "fancy" work, he may make the castings of brass and polish them all over; but if he wants the best construction he will use cast iron, and if the end be painted it will do its work as well as though polished—in fact, I have had the neatness of this detail made in this way, commented upon more times than any equally simple detail that I ever devised. Wear may be taken up by filing the joint, or paper may be inserted in the joint before boring the hole.

The rod is held in place in the sockets by Pratt & Whitney taper pins, as clearly shown. These pins may be bought in quantities like set screws, together with suitable reamers, and they form a means of connecting many parts together whose cheapness and neatness are not half appreciated.

There is one little wrinkle connected with their use for this purpose which is essential to success: If the pins be put in, as might be inferred from the sketch, the alternate pull and thrust will inevitably work them loose. To avoid this, drill and ream the holes with the rod firmly bottomed as shown. Then take the rod out of the sockets and insert a disk of paper in the hole, or put a washer of paper under the shoulder, and put the parts together again. This gives the holes a slight offset, and the taper of the pin gives a key draft, drawing the parts together. With this plan there is no trouble with the pin getting loose. Just why would be hard to put in words, though every mechanic can feel the reason. The offset of the holes need not be large—the thickness of paper giving the same key effect that a quarter of an inch clearance would do. Of course, the same effect can be obtained by filing opposite sides of the holes in socket and entering piece. The essential thing is the key draft.

I would like to ask why this construction could not be used on the numerous rods about a Corliss valve gear, with a decided saving in cost. The ready answer will probably be that some provision for adjustment is necessary in these rods. So far as the eccentric and reach rods are concerned, I can see no reason why they cannot be made to the correct length as well as similar rods on other engines. Adjustment for the valves is, of course, necessary; but why cannot this be secured by a simple pinch grip of the rock arm on the valve spindle, and with a saving over the present keyed-on style? The adjustment of the dashpot drop rods could be obtained by a sliding pinch grip between a stem on the piston and a socket carrying the pin with which the drop rod engages. With the adjustment removed from the rods themselves, they could be made from finished shafting, at a large saving over the common construction, which involves a hexagon at the center with turned and threaded ends and jam nuts, while the usual pattern of box end with inserted piece for taking up wear is certainly more expensive and no better than the simple style here shown.

Having broken away from the principle of the shoemaker sticking to his last, I would like to make another suggestion: My experience with the pins leads me to suggest the use of the same principle of a key draft with taper bolts as used in so many places about locomotive frames. These, as usually put in, take the thrust in both directions and give much trouble from working loose, precisely as these pins do if the precaution described is neglected. If the bolt holes were filed out so as to give a draft to draw the parts against a shoulder, I believe the results would be much better. Where there is no shoulder, half the holes could be filed one way, and the other half the opposite way. This would divide the bolts into two sets, each set drawing against the other; and while at first sight it looks like sacrificing the strength of half the bolts, as only one-half would resist the strain in one direction, while the other half would act for the opposite strain, I believe it would be well worth trying.



ECCENTRIC ROD CONSTRUCTION.

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The old adage that "there are two sides to every question" is of universal application only when we admit that in some cases the two sides are the right side and the wrong side. The two so-called "mechanical" questions, about the relative

speed of the top and the bottom of a locomotive driving wheel, and as to whether the crosshead stops at the end of the stroke, have now a fitting companion, although not "mechanical," in the question as to when the nineteenth century ends.

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Bevel Gear Curves.

BY H. W. ALDEN.

Recently, the writer had occasion to figure the angles and diameters of a pair of bevel gears. I tried Grant's Bevel Gear Chart, the extensive use of which precludes the necessity of further explanation here, but did not find there the ratio required. This caused me to think that a table or set of curves might be made to cover all ratios, and the result was that the three sets of curves attached were plotted.

The method used is explained below somewhat fully, in order that the scope of the curves may be better understood. Starting with the first step in figuring bevel gears, I began with the center angles and laid off on the base line abscissæ representing the ratio of pinion and gear, assuming this rather than the reverse ratio, because a larger scale and one more easily used could thus be obtained. Ordinates were laid off representing degrees from 0 to 45 on a scale large enough to permit tenths to be estimated accurately. Then, taking those proportions given in the chart, points were plotted and a smooth curve drawn for the pinion and the same for the gear. From these two curves, center angles can be read off directly for any two bevel gears at right angles, the two pitch diameters alone being given.

Similarly, sets of curves were drawn for the angle and diameter increment constants, the ratio of pinion to gear being taken in every case and plotted on the same scale for the sake of uniformity, the other scales being taken as large as possible, allowing readings to be made from them to three figures.

Granted that the chart itself be accurate, and its extensive use proves it practically correct, the curves must be equally accurate and certainly are more complete and easily used.

It is needless to say that the two curves in each set are companions only for bevel gears with shafts at right angles, but are, at the same time, equally applicable to all cases. When the shafts are not at right angles, the center angles may be obtained graphically or by the following formula:

$$\tan. A = \frac{\sin B}{R + \cos B},$$

where A = center angle of gear;
B = shaft angle;
R = ratio given above, *i. e.*, of pinion to gear.

Subtracting center angle of gear thus found from shaft angle gives center angle of pinion.

Using these center angles as starting points, find from center angle curves the ratios corresponding to the two angles found above, and then from these two ratios use the other curves separately for pinion and gear, as if each were one of a pair of right-angle bevel gears.

Below are given two examples showing the use of the curves:

Example 1—Given two bevel gears at right angles, 12″ and 16″ pitch diameter and 10 pitch: Find complete dimensions.

(*a*) Center angles from curve No. 1.
Ratio = $\frac{12}{16}$ = .75 and angles corresponding are:
(1) Gear = 53.°15
(2) Pinion = 36.°85

(*b*) Face angles.
From curve No. 2 over ratio of .75 we find angle increment constants.
(1) For gear = 92. Divided by 160 = °.57
Face angle = 53.°15 + °.57 = 53.°72
(2) For pinion = 68.9. Divided by 120 = °.57
Face angle = 36.°85 + °.57 = 37.°42

(*c*) Cut angles.
(1) For gear = 53.°15 − °.57 × 1.166 = 53.°15 − °.65 = 52°.50
(2) For pinion = 36.°85 − °.57 × 1.166 = 36.°85 − .65 = 36.°20

(*d*) Diameter increment from curve No. 3.
(1) For gear = 1.20 divided by 10 = ″.12
(2) For pinion = 1.595 divided 10 = ″.1595 = ″.16

(*e*) Extreme diameters of blanks.
(1) Gear blank = 16.″00 + ″.12 = 16.″12
(2) Pinion blank = 12.″00 + ″.16 = 12.″16

Calculating these quantities accurately by trigonometry, the correct values are:

(1) Gear.
(*a*) Center angle = 53.°12
(*b*) Face angle = 53.°12 + ″.58 = 53.″70
(*c*) Whole diameter of blank = 16.″12

(2) Pinion.
(*a*) Center angle = 36.°88
(*b*) Face angle = 37.°46
(*c*) Whole diameter of blank = 12.″16

Example 2—Given two bevel gears of 12″ and 16″ pitch diameter, 10 pitch with shafts at 60°:

(*a*) Center angles.
From formula,

$$\tan. A = \frac{\sin B}{R + \cos. B} = \frac{.866}{.75 + .50} = .692$$

A = 34.°68 = center angle of one gear.
60.°00 − 34.°68 = 25.°32 = center angle of other gear.

Now, since the angle chosen gives the center angles for both gears less than 45°, we must treat them as pinions and use the pinion curves in all cases.

From curve No. 1,
34.°68 = ratio of .693
and 25.°32 = ratio of .535

(*b*) Face angles.
(1) For large gear. From curve No. 2, over ratio .693, find angle increment = 65.3. Divided by 160 = °.41. Face angle = 34.°68 + °.41 = 35.°09
(2) For small gear. From curve No. 2, over ratio .535, find angle increment = 53.8. Divided by 120 = °.45. Face angle = 25.°32 + °.45 = 25.°77

(*c*) Cut angles.
(1) For large gear = 34.°68 − °.41 × 1.166 = 34.°20
(2) For small gear = 25.°32 − °.45 × 1.166 = 24.°80

(*d*) Diameter increment from curve No. 3.
(1) For large gear = 1 64 divided by 10 = .164
(2) For small gear = 1.77 divided by 10 = .177

(*e*) Extreme diameters of blanks.
(1) Large gear blank = 16.″164
(2) Small gear blank = 12.″177

Calculating these quantities trigonometrically as before, we obtain the following values:

(1) Large gear.
(*a*) Center angle = 34.°68
(*b*) Face angle = 35.°10
(*c*) Whole diameter of blank = 16.″164

(2) Small gear.
(*a*) Center angle = 25.°32
(*b*) Face angle = 25.°74
(*c*) Whole diameter of blank = 12.″181

It will thus be seen that the largest deviation of the results gotten from the curves is °.04 and ″.004, neither of which is of any consequence.

Hartford, Conn.

▲ ▲ ▲

Flow of Compressed Air in Pipes.

BY WILLIAM COX.

I have been unable to acknowledge more promptly Mr. Halsey's kind appreciation in the "American Machinist" of August 27th, of what I have done in suggesting Darcy's formula as a suitable one to be applied to the flow of compressed air in pipes, and in bringing out my computer, which solves the same for any factor in less time than it takes to write out the problem.

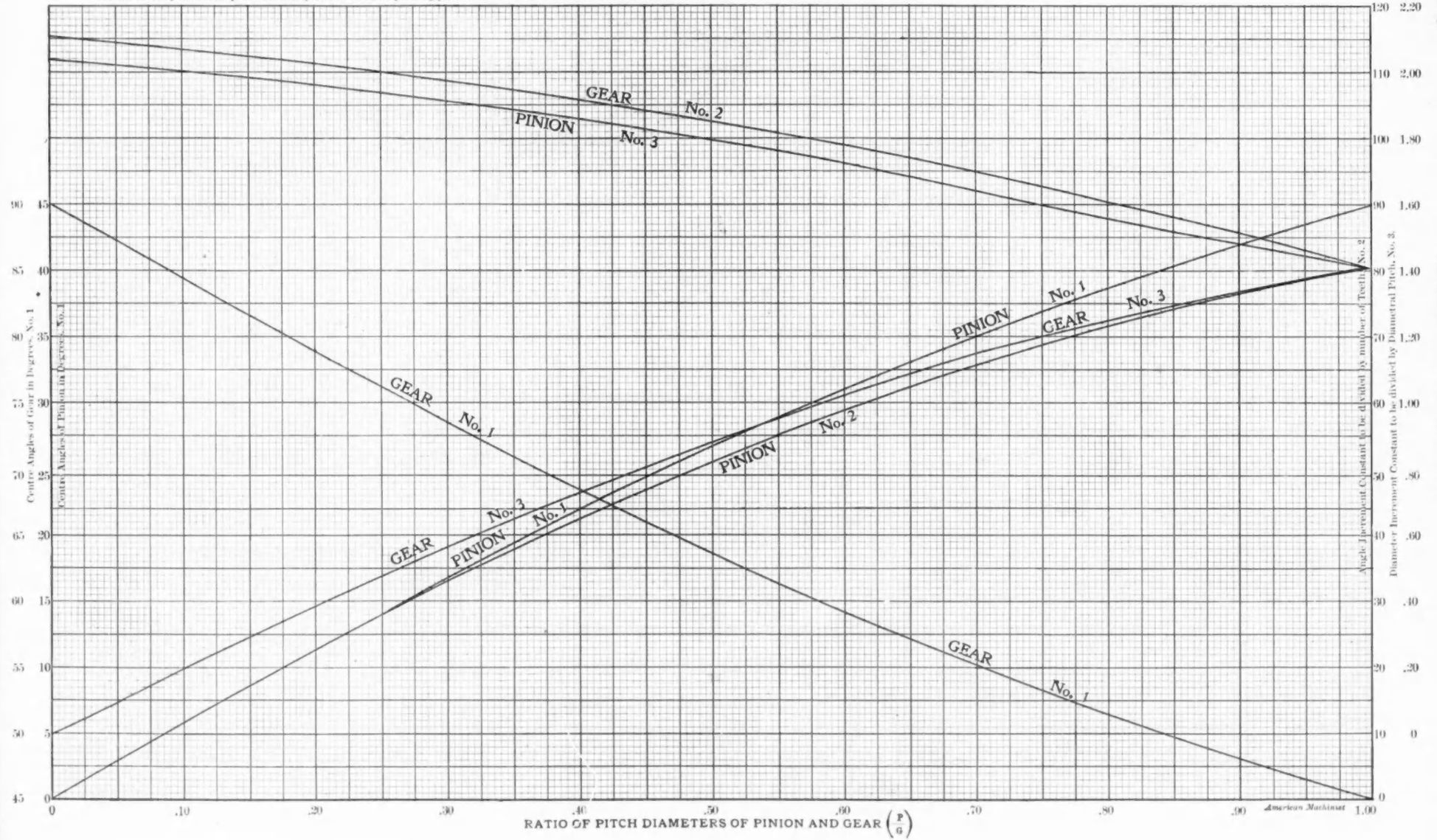
Before making a few further remarks on this subject, which seem to me to be called for owing to a certain tendency to misconception, I would say in reply to Mr. Halsey and in reference to my last problem (August 20th), that I merely assumed an imaginary case, easy of calculation, as the fall of pressure was one atmosphere per section of pipe, to show what, according to the formula, was going on in the pipe during the transmission of the air, namely: (1) A continuously increas-

BEVEL GEAR CURVES.

PLOTTED FROM GRANT'S BEVEL GEAR CHART BY H. W. ALDEN.

Instructions:

TO FIND CENTER ANGLES, CURVES No. 1 Divide pitch diameter (or number of teeth) of pinion by that of gear and over corresponding ratio on base line find center angles of pinion and gear on their respective curves.
TO FIND ANGLE INCREMENTS, CURVES No. 2 Divide pitch diameter (or number of teeth) of pinion by that of gear and over corresponding ratio on base line find angle increment constants for pinion and gear on their respective curves; Divide these by number of teeth in corresponding gear and add quotients to center angles to get FACE ANGLES of blanks. Multiply the above quotients by 1.1667 and subtract product from center angles to get CUT ANGLES of gears.
TO FIND DIAMETER INCREMENTS, CURVES No.3 Divide pitch diameter (or number of teeth) of pinion by that of gear and over corresponding ratio on base line find diameter increment constant for pinion and gear on their respective curves Divide these by diametral pitch and add quotients to corresponding pitch diameters to get extreme diameters of blanks.


GEAR No. 2
PINION No. 3
GEAR No. 1
PINION No. 1
PINION No. 2
GEAR No. 3
GEAR No. 1
PINION No. 3
GEAR No. 1
PINION No. 1
Centre Angles of Gear in Degrees No. 1
Centre Angles of Pinion in Degrees No. 1
Angle Increment Constant to be divided by number of Teeth No. 2
Diameter Increment Constant to be divided by Diametral Pitch, No. 3.
RATIO OF PITCH DIAMETERS OF PINION AND GEAR (P/G)
American Machinist

ing volume of compressed air passing a given point in the same unit of time; (2) a diminishing density of that volume, and consequently, (3) an increasing velocity of that volume.

If this formula is not applicable to such considerable losses of pressure, then I would suggest that those who have the means and the necessary appliances set to work to determine exactly where the dividing line is to be drawn, and what new series of modifying co-efficients or what new factors are required to make the formula applicable to high as well as low losses of pressure.

In all questions and discussions regarding the flow of air in pipes, it is absolutely essential to bear in mind whether the flow of *free* or *compressed* air is being considered, as some of the conditions and effects are reversed in the two cases. But how can the flow of free air in a pipe be consistently considered, as such a thing does not exist except in special cases? Formulas relating to the flow of fluids all give the volume of discharge of such fluid in such condition as it is discharged. In the case of air under pressure, free air is not discharged, but compressed air under a given terminal pressure; also, free air does not flow through the pipe, but compressed air under a continually diminishing pressure. How, then, can we talk of the flow of free air whose density is constant, and the discharge of free air from a pipe; and yet every operation of air compression requires the solution of the problem? If the air discharged from the end of a pipe is to drive a pump or other machine, the volume of air necessary at a given pressure to do the work must be known; but the compressor maker bases all his calculations on the amount of free air furnished to the pipe from the receiver. This double method of considering air has led to some confusion and to some errors.

It is not difficult to devise a formula which shall give the discharge reduced to free air, but it takes a form such that it can only be solved by the tedious process of approximation. It is therefore more practicable to use a formula giving the discharge in compressed air, and then convert the result to the equivalent volume of free air.

In order that there may be no misunderstanding on the subject of the statement that the loss of pressure is proportional to the length of pipe when considering *compressed* air, I think it well to give an illustration so as to make my meaning clear:

Suppose an 8-inch pipe, with an initial pressure of 60 pounds. The discharge of compressed air with a loss of 5 pounds at the end of 1,000 feet would be 1,200 cubic feet, at 55 pounds final pressure; at the end of 2,000 feet would be 1,200 cubic feet, at 50 pounds final pressure; at the end of 3,000 feet would be 1,200 cubic feet, at 45 pounds final pressure; and so on for other proportionate lengths.

Only in this sense can the loss of pressure be said to be proportional to the length of the pipe, as shown by the formula, and then it is seen that it is offset by the decreased volume of equivalent free air discharged, which in this case means a smaller intake. It clearly follows that, view the matter as we will, the loss of pressure should never be taken in practice as being proportional to the length of the pipe.

[My contention that the loss of pressure is not proportional to the length of the pipe, was in reference to the actual conditions of practice where the same weight of air must pass every section of the pipe. With this position Mr. Cox agrees—F. A. H.]

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De La Vergne Big Boring Mill.

The De La Vergne shops, Port Morris, N. Y., have some very large work in hand at the present time, larger than their regular tools would handle, though they had a large Niles 3-spindle cylinder boring machine. The shop was therefore obliged to put in a new boring mill, and this was home-made, has very recently been introduced and is an excellent machine, large enough to bore a cylinder 140 inches diameter and 16 feet long. The two boring bars are 12 inches and 24 inches diameter, respectively, fitted with boring heads of various sizes which are fed along the bar by the usual screw, driven by a star feed at variable rates of advance in either direction, by a very simple device consisting of two circles of pins, one inside the circumference described by the axis of the star wheel shaft as the bar revolves, and one outside; the star-actuating pins are placed in the outer circle of holes to feed in one direction, and in the inner holes to feed the other way.

This boring mill is framed, above the level of the shop floor, by the walls of the building in old-time fashion, cast-iron upright ways with finished square guides being bolted to the brickwork to support and direct the 4-armed crosshead which makes the top support of the bar. Only two of the four crosshead arms are thus guided and secured to wall-supported ways. The other two are short, and serve to carry down-hanging set-screw brackets for steadying the top of the work. The whole machine is very large and very heavy, and, as is the usual

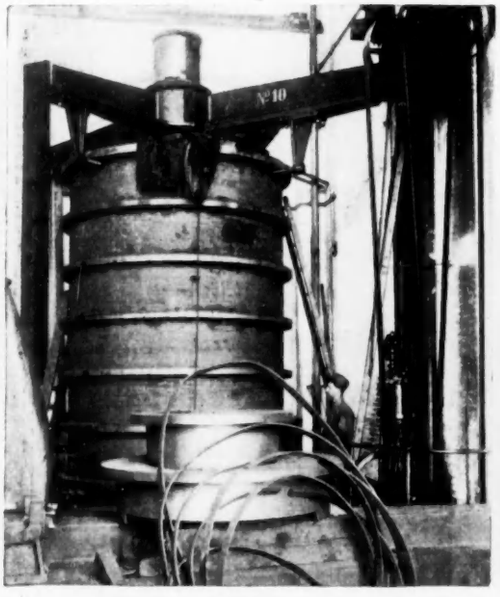

Fig. 2. BORING MILL, WITH COTTON PRESS CYLINDER.

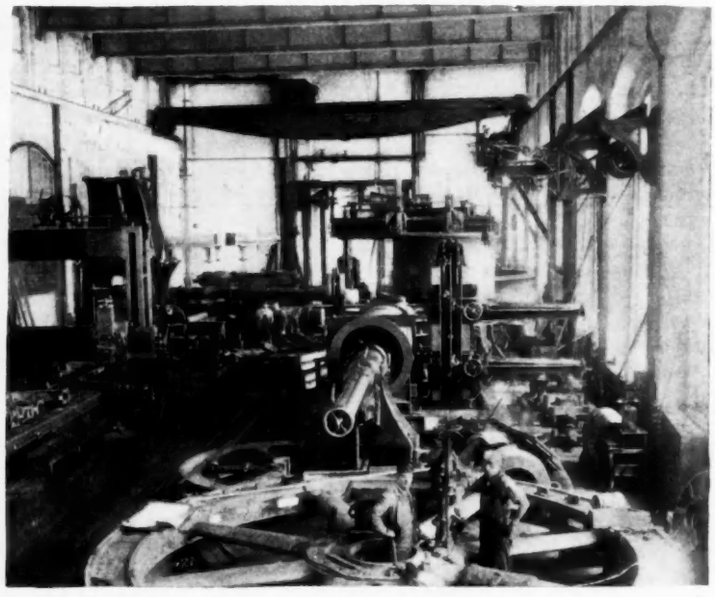

Fig. 1. DE LA VERGNE "HEAVY FLOOR," LOOKING EAST.

case with tools built by a shop for home use, the few drawings made were pencil sketches, fragmentary and incomplete, and exact cost figures were not to be had. I should say the cost was probably little if any below $6,000.

It is really a misfortune that the actual cost figures of a home-made tool are never to be had. Such tools commonly cost, I believe, a good deal more than the management expects them to cost, and there is often a feeling that they cost more money than need have been expended, and the result is an indisposition to collect the construction particulars of the job; the management does not care to see the statement, knowing the new tool cost enough, anyway, and the cost clerk has enough else to attend to, so he does not trouble himself with the total, and the superintendent, who knows the work cost more than he thought it would, is quite content to let the matter rest.

The De La Vergne shops have two distinct drawing rooms, the main room with a large force making full and carefully finished sets of drawings for its regular work, and the tool construction drawing room, where three or four men who can carry the details of half-a-dozen special tools in their heads at the same time look out for work coming along in the shops, and make just as few pencil marks on manilla paper as will suffice to jog their own memories. No drawings of this boring mill were made; only a few pencil sketches; but the management was kind enough to have the small scale plan and elevation of the machine given in Figs. 3 and 4, and the construction section of the large boring bar, Fig. 5, and the boring bar step, Fig. 6, and the sketch illustrating the star feed, Fig. 7, made for use here, for which the thanks of the reader are deserved and will doubtless be given. For the rest the camera had to serve, though the heavy work floor of this shop is now so crowded that but for the traveling crane nothing could be done there, and no such thing was possible as choosing points of view for a picture.

As a general rule, the modern shop avoids the use of the wall for any purpose whatever outside of its architectural function. The old machine shop used the walls as a place for storing everything which could not safely lie on the floor; patterns and drawings on pine boards, strings of nuts and washers, file racks and small tools of all kinds, bundles of wire, and the skin of belt lacing from which each hand cut with his jack-knife such strips as he wanted, all hung on the wall, together with the street clothes and towels and dinner baskets of the workmen, in a manner that would not now be tolerated, and when the walls were full the rest of the plunder was hung to the beams overhead. It was also considered quite the thing to suspend drills from the overhead work, and to plaster drills and even small lathes up against the side walls in the long spaces between the windows. All this slovenly disposition of small stock, light tools and the workman's personal property has gone never to return, and save in the one solitary case of the vertical boring mill, no modern shop is likely to use the walls of the building for part of the framing or support of any machine tool whatever. In this one case of the vertical boring mill, however, it seems indisputably an economy to utilize a shop's corner walls, as has been done. The angle of the heavy brick walls gives a perfectly good support for the cross-head ways, with abundant mass to insure steadiness, and abundant strength to resist the not very great side-thrust of the boring tools. It is true that the cut might come so as to give the wall a push of a ton or two outward, but such a stress gradually applied is well within the wall resistance. There is also a very great sav-

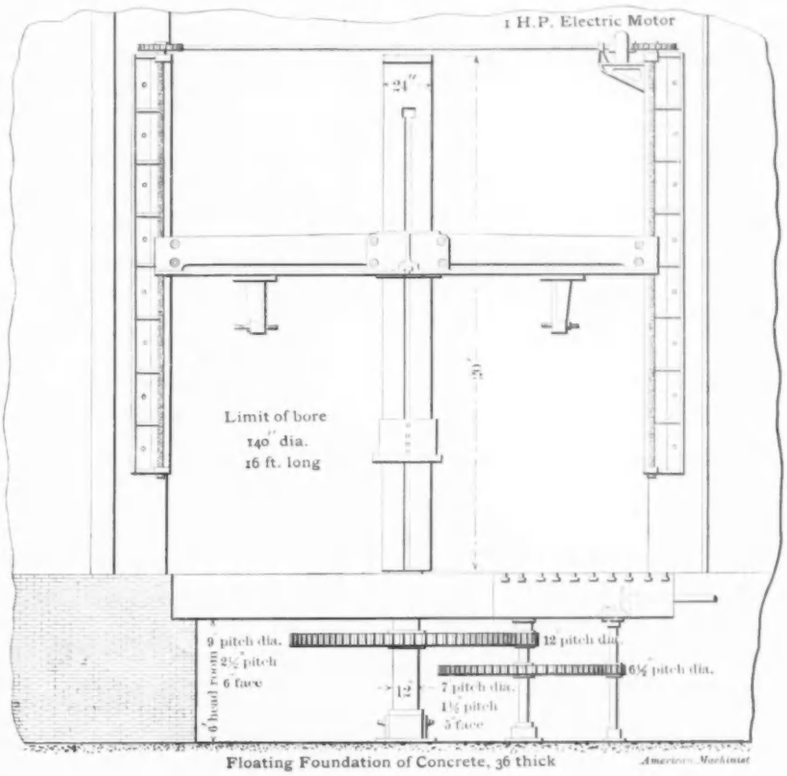

Fig. 3

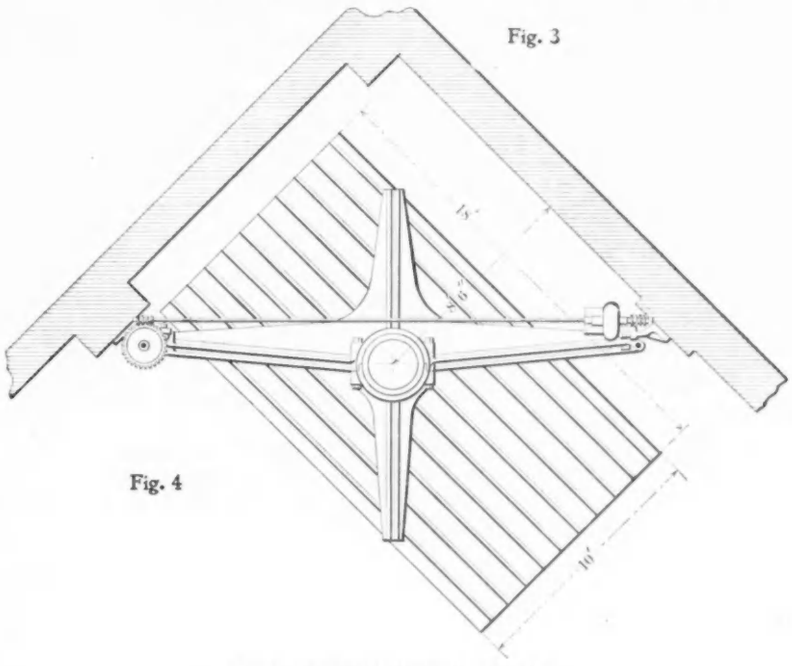

Fig. 4

PLAN AND ELEVATION OF MILL.

ing of floor room gained by locating such a machine in a corner, as well as the saving of the cost of an independent structure reaching up 20 feet or so above the floor, and framed in sufficient weights of cast iron to gain a freedom from vibrations which would approach the steadiness of the shop walls.

The soil under the part of the shops where this mill stands affords a poor foundation, as it was formed by filling the bed of a small creek formerly running about 18 feet below the present floor level, so that digging reaches mud which grows softer as it lies deeper. Consequently the excavation was stopped at 11 feet below the floor line, and a floating foundation of concrete 3 feet thick, about 15 x 22 feet, was put in; on top of this 18-inch brick walls, 6 feet high, were built, inclosing the gear pit, and on these walls the T-grooved sole plate, 10 feet wide, 18 feet long and 24 inches deep, was laid. The gear pit is accessible by a trapdoor and stairway next to the right-hand wall in the plan, Fig. 4.

Two boring bars were provided, each 20 feet long, one 24 inches diameter and the other 12 inches. The gears have cast teeth, and the drive is a vertical engine of about 10 horse-power.

Fig. 1 is a general view of the east third of the heavy shop floor; the crosshead of the big boring mill is barely discernible in the far left-hand corner of the room. At the left is a large Niles planer, in the middle right is the large Niles 3-spindle Corliss cylinder boring mill, and directly beyond is a large Niles horizontal face-plate boring mill, at the end of the room. Some slotters are hidden between the two boring mills.

Fig. 2 shows the new boring mill with a cotton press steam cylinder in it; the vertical engine which drives the mill is shown at the right, and the figure of the workman standing between the engine and the cylinder gives an idea of the size of the work. This cylinder had a bore 100 inches diameter by 152 inches long, I think.

The bed plate weighs 22 tons; the wall brackets or guides each 3,670 pounds; The spider No. 9,104 weighs 7,250 pounds, and spider No. 9,105 weighs 2,475 pounds; the 24-inch boring bar weighs 18,200 pounds, and the 12-inch bar 4,190 pounds. The weights of the smaller parts I did not obtain, nor that of the gearing; the whole mill weighs perhaps 60 or 65 tons.

The 3-foot bed of concrete, 15 x 22 feet, has an area of 330 square feet of "floatage" on the soft soil beneath, and is consequently loaded, in case of extremely heavy work, in the mill, to less than half a ton to the square foot; hence, gives very ample support, as the poorest soil is supposed to carry a ton to the square foot with safety.

H. L. Arnold.

Machine Shop Oculists.

In the course of metal-cutting operations, small chips and slivers of metal fly in unexpected directions at rapid rates of travel, and these particles of metal often reach the machinist's eye with annoying and sometimes serious results. The eye is small, and the machinist learns early in the business to wink quickly, and there are plenty of places in the shop where there are no eyes to be found, yet the little, swift, hot chips manage to reach a workman's eye very frequently. The lathe hand may have his head close down to his work, and, with a snap, a little, very hot, chip of tool steel shoots into the corner of his eye; the prompt wink is just in time to shut the burning chip tightly between the eyelids, while the tears stream out and cool it. This form of eye-seeking chip is commonly large enough to drop out when the man with the burned eye obtains sufficient control of his muscles to unclose the eyelids, which is never done while the chip is hot enough to burn;

as long as it burns the wink holds on tight, and when the chip don't burn any more, then the eyelids open and drop the chip, so that in this case the services of the shop "eye-picker" are seldom called for.

The most common "something in my eye" in the machine shop is a small piece of cast iron about the size of a billiard ball, and having a surface composed wholly of sharp edges, if the sensations of the eye which harbors the chip are reliable indications of its size and shape. With this sort of chip in his eye the experienced mechanic winks just once, then he shuts the eye with the chip in it up tight and starts for the "eye-picker," who rubs the thumb and forefinger of his left hand on his overalls to remove what loose machine oil and fragments of iron they may carry, and then proceeds to open the suffering eye to the light, and search carefully until he finds the often minute particle of metal which causes the annoyance, and to pick it out of the eye when found, with the sharpened end of a match or little pine stick. "Some "eye-pickers" chew the end of the stick into a little brush; others use a sharp-pointed knife-blade, sometimes magnetized, to pick out the chip; but a pine stick whittled to a point is the favorite instrument, I think. Often the chip is firmly hooked into the fold of soft skin which joins the eye-ball and tne lid, and is difficult to remove, and the "eye-picker" sometimes has fine-pointed "pick-up," or jeweler's tweezers, in his kit, with which he removes adhering particles of metal from the inner eye or eyelid surfaces. It is by no means uncommon for a large swiftly-flying piece of jagged metal to cut the eye-ball so as to cause the fluid part of the eye to drop out, destroying the sight forever; this is not a case to be treated by the "eye-picker;" a handkerchief is tied over the eye, and the mutilated workman, who commonly suffers very little pain, goes in search of a surgeon.

The most difficult and painful cases treated by the shop "eye-picker" are those in which a slender needle of metal, flying rapidly endwise, enters the "sight" or cornea of the eye a greater or less distance, and sticks fast with its outer end projecting so that it scratches the eye lid in a most painful manner. Such a needle in the white of the eye is readily discoverable, and is either pulled out with the "pick-up" or cut out by very careful use of a sharp knife-blade in the hands of the thoroughly experienced "eye-picker," who is an expert of cool nerve and much confidence gained by long and varied practice. The man who owns the injured eye is expected to hold it still, directing his gaze as ordered by the "eye-picker;" this also requires some nerve and experience. In the case when such a steel needle enters the colored part of the eye, it is often very difficult indeed to locate; the most careful scouting by the "eye-picker" fails to discover the little point of projecting metal which cuts the eyelid so cruelly at every wink. In this case the "eye-picker" passes the smooth back of a knife blade slowly over the pupil of the eye until the steel point is detected by touch, and then carefully turns the patient's head before the light until he catches the reflection on the steel point. Once found, if the end projects sufficiently to afford a hold for the "pick-ups" the sliver is drawn out with a steady pull. If it does not afford a hold for the "pick-ups," the "eye-picker" works about the sliver with the very sharp point of his knife blade, until the carefully oil-stoned "pick-up" points can obtain a hold.

The "eye-picker" is really a specialist of no mean degree. To begin with, he has the nerve and instincts of the surgeon, and his shop diploma is founded on successful practice; it is quite likely that he is innocent of all knowledge of the internal structure of the eye, but he may operate five or ten or twenty times a day on the eyes of his shopmates, and he has a steady hand and knows exactly what he is about, and is really to be preferred, for the class of cases which he treats, to any but the very best of professional oculists. I never knew a shop "eye-picker" to injure

an eye in the course of his operations, and the prompt relief afforded by the removal of the chip before inflammation begins is of very great advantage. Sometimes the patient does not hold his eye still, and the "eye-picker" throws up the job in disgust, and the consequence is a day or two of lost time for the sufferer, beside a doctor's bill to pay. A jagged bit of metal sticking in the eye overnight deprives the sufferer of sleep, and makes the swollen and inflamed optic difficult to treat the next day.

Some workmen very often have something in the eye; others almost never suffer in that manner; long eye lashes are a very great protection, and glasses wholly shield the eyes; but pure carelessness seems to be the cause of most accidents to the eye in the machine shop. The hammer-and-chisel-using "chipper" has almost disappeared, but any man who passes a "chipper" at work without screening his eyes from the possibility of injury from a flying piece of metal is very careless. John Justin, a foreman under whom I worked for some years, lost an eye by a flying chip from a chipper's chisel, and John McKee, a shopmate in the same shop, lost an eye the same way. I never thought of it until now, but the vast increase of "machine cuts" has certainly greatly reduced the number of serious accidents to the eyes of workmen in the modern shops.

Dr. McNaughton, to whom I have just read this, says the "eye-picker" should have "clean" hands, and rinse them in a solution one part of bichloride of mercury to 2,000 parts of water; and also, that if the "eye-picker" will use an "eye-dropper," one of those little glass tubes with a rubber bulb at the end, and drop two or three drops of a 4 per cent. solution of cocaine in the patient's eye before he begins to hunt for the chip, the sensitiveness of the eye will be greatly reduced for some time, and thus make it much easier for the patient to hold his eye still while under treatment.

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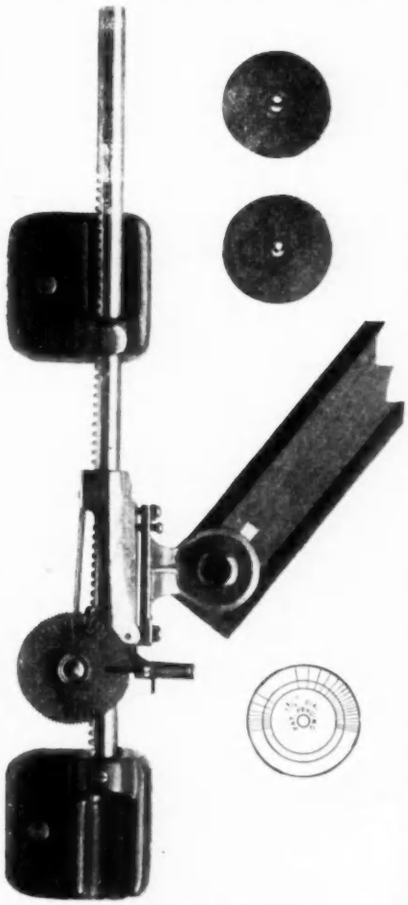
A Universal Section Liner.

The work of section lining is a tedious one to the draftsman, and devices that attempt to lighten the task and quicken its accomplishment are perhaps sufficiently numerous. The number of these devices, however, has little to do with their chance of employment, since the one that is best, or the one that most satisfactorily fulfills the requirements, may be worth more than all the rest. Section liners that have been devised have generally been inapplicable to more than a limited range of work, or have entailed some inconveniences if applied more widely.

The section liner which is shown in the acompanying half-tone seems to have a wider range of adaptability than any other with which we are familiar. As it will make lines of any predetermined distance apart, it is not merely a section liner, but also a graduating instrument, and the various measures of a drawing, and the position of any desired lines on a drawing, may be laid off by it without the employment of a rule or graduated scale. The instrument consists first of the round central rod with heavy feet on each end, which may be slid along the rod and fastened at any point, so that the rod may be used longer or shorter, as may be most convenient. The weight of the instrument is usually sufficient to hold it in any location upon the board, although a sharp-pointed screw is provided in each foot to help to secure the instrument from slipping. The



A NEW SECTION LINER.

carriage which carries the ruler is moved along the rod by means of a pinion working in a rack on the side of the round rod. The ruler may be set at any desired angle to the rod. The edges of the ruler are of transparent celluloid, so that the work may be seen as it is progressing; the ruler may also be swung up and returned without losing its position. The ruler is moved along by turning the large graduated disk, which is upon the same spindle with the pinion. For ordinary section lining no attention is paid to the face of the disk, and the eye is not employed for determining the movements. The edge of the disk is provided with a series of notches, and a little spring throws a sliding catch into each notch as it passes. If coarser or finer lines are required, other disks are provided with different numbers of notches. Graduations coarser or finer than those resulting from the use of either of the notched disks may be obtained by placing the instrument at a different angle to the work.

If the graduated face of the disk is used to determine the movement of the ruler, the spring catch is thrown out, and the wheel then turns smoothly in either direction, and the graduations upon it may be read the same as the measures upon a graduated scale, and the ruler may be moved accordingly. This instrument also provides a ready means of shading cylindrical surfaces, paper disks being provided which give the location and correct spacing for every shade line upon a cylinder of any given diameter. One of these shade line disks is shown lying on the paper beside the instrument. Many interesting and ingenious specimens of work done with the aid of this instrument have been shown us, but it is not necessary to reproduce them here. The instrument is also made as a part of a T-square and in various styles and sizes. The makers are Wm. Gardam & Son, 98 John street, New York City.

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A New Lathe Chuck.

BY F. A. HALSEY.

At a recent visit to my old stamping ground—the shop of the Canadian Rand Drill company—the foreman, Mr. Andrew Sangster, showed me a lathe chuck of his which has proven so useful as to deserve a description.

The chuck is such an unpretending affair in appearance that I did not take in its usefulness at first sight; and I fear my interest in it was somewhat lukewarm until Mr. Sangster began to pull out the various jobs which he had done with it. As the bench began to fill up and other things got crowded off on the floor, the usefulness of the chuck became clear. A printed and illustrated description alone will no more make its usefulness clear than did the chuck itself, and, consequently, a number of representative pieces of work done with it will also be shown.

The chuck is shown in Fig. 1, and consists of a simple sleeve threaded to fit the lathe spindle, bored and faced at its outer end, and split longitudinally, with two clamping bolts to grip whatever turned piece may be put in it. These turned pieces are usually stumps or other shapes for holding the piece actually being made, such as might be used in a common three or four jaw lathe chuck, but with the difference that with the present device these stumps may be laid aside when the job is done and be used again when it comes up again, with the certainty that when put in the chuck they will run true as at first. In other words, this chuck is a sort of master chuck which enables cheap perma-

nent fixtures to be made for many jobs which would otherwise require much more expensive ones, or else would be made each time by temporary and makeshift devices.

Fig. 2 shows one job done with the chuck—a simple brass ring which is required to be threaded on the outside and the stump being correspondingly tapered. Recesses are, of course, cut in the stump to clear the lugs in the ring.

Fig. 4 is a cylindrical piece with an eccentric hole, which had to be made in considerable quantities and quite accurately in the eccentricity. The fixture is shown in Fig. 5 , the left-hand end fitting is placed on the stump, Fig. 7, and the outside is then done. In this case the stump has a Morse taper at the chuck end and is inserted in a corresponding socket placed in the chuck. This method has obvious advantages for small stumps made of steel.

Fig. 8 is a small connecting rod end

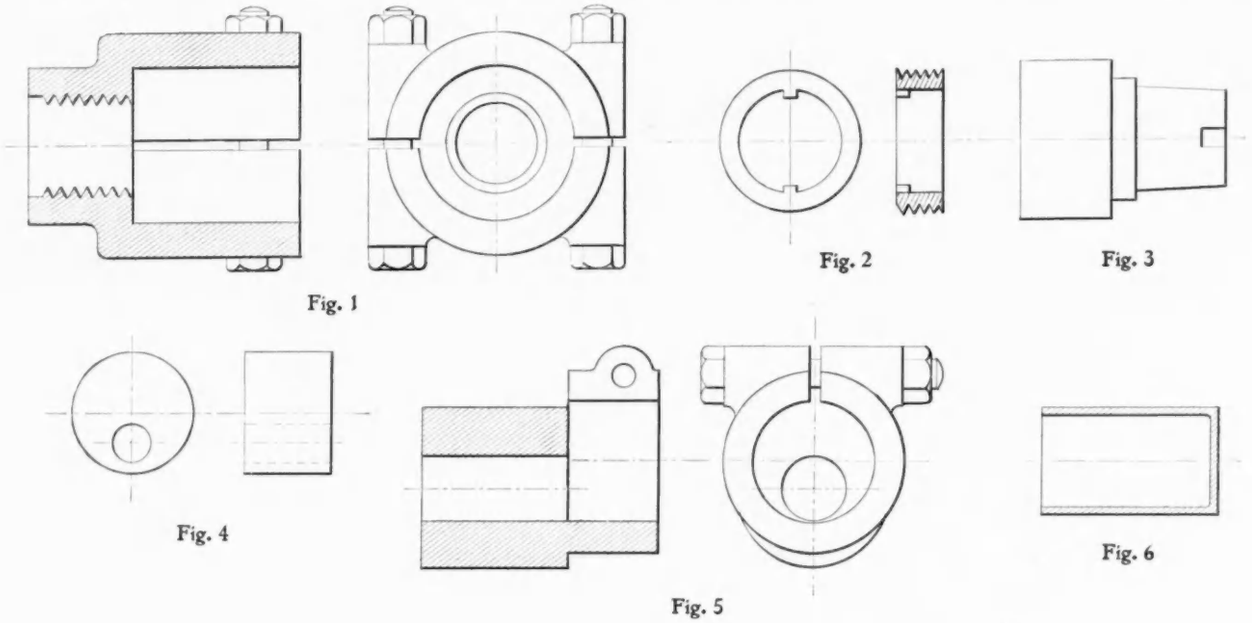

Fig. 1 Fig. 2 Fig. 3

Fig. 4 Fig. 5 Fig. 6

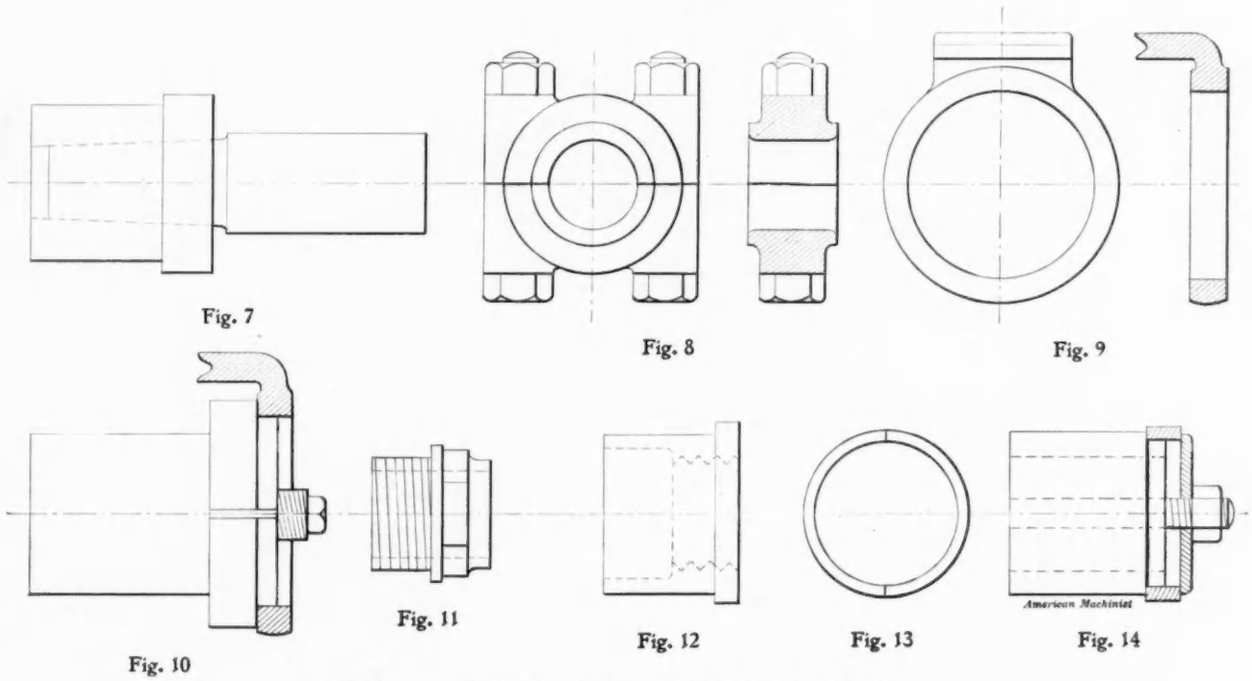

Fig. 7 Fig. 8 Fig. 9

Fig. 10 Fig. 11 Fig. 12 Fig. 13 Fig. 14

SANGSTER'S LATHE CHUCK AND SAMPLES OF ITS WORK.

to be faced on one side. The inside of the ring is left rough and has two lugs for screwing it in place. This ring is made on the stump shown in Fig. 3, which is turned at the left-hand end to fit the split chuck, while the right-hand end is turned to take the ring as it comes from the sand—the hole in the ring having the taper due to the draft of the pattern, and the chuck, and the right-hand end being bored to receive the previously turned job and holding it by the pinch bolt. The eccentricity of the fixture fixes that of the work, of course.

Fig. 6 is a hollow brass casting required to be finished all over, inside and out. The first operation is to bore out the inside in a common chuck, after which it faced on the two sides and bell-mouthed at the ends of the bore. This piece is chucked in the ordinary way for boring the hole and facing one side, but is then reversed and pinched on a stump similar to Fig 7, for facing the second side and forming the bell mouth of that side.

Fig. 9 is a ring with an ear rising from one side. The ring is required to be

faced on both sides and bored. It is first caught in a common chuck, with the ear projecting outwardly, and the hole is bored and the outside face gone over. It is then reversed and put on an expanding stump, shown in Fig. 10. The taper plug in the center grips the ring and enables the second side to be faced.

Fig. 11 is a threaded brass bush with a hexagon head, and is required to be machined all over, inside and out. It is first caught in a common chuck by the hexagon end, and the threaded end and hole are finished. It is then reversed and screwed into the bush, Fig. 12, which, of course, is carried by the chuck, leaving the remaining surfaces ready for the tool.

Fig. 13 is a rock-drill piston ring, which is of steel and made in halves, the joint being made before the lathe work is done in order to avoid the open joint which would result from cutting open a solid ring. After the joint is made, the rough halves are caught in a chuck, the hole is bored, and the sides faced at the same setting, leaving only the turning to be done. The ring is then mounted on the stump, Fig. 14, to which it is pinched by the washer and the bolt which goes through the hollow spindle of the lathe. It should be explained that this is not the regular method of manufacture of these rings, but a special one adapted to rings of a size of which but few are made. In fact, nearly all of the jobs shown are of that class which, while not made in quantities sufficient to justify fully developed manufacturing methods, are yet of regular occurrence in the shop in fair-sized lots.

The tools shown cost but little—in fact, in several cases were made from scrap pieces.

The different pieces of work shown are only representative; but they show the utility of the chuck, which, as Mr. Sangster says, "is young yet."

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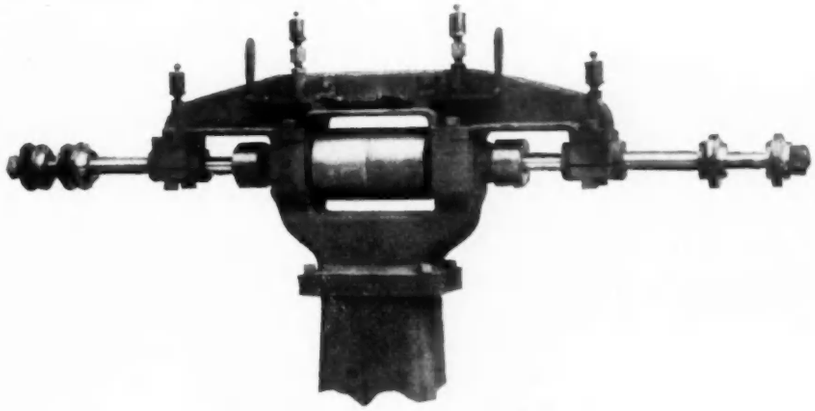
Attachment for Grinding Formed Cutters, Reamers, Taps, Etc.

The Brown & Sharpe Manufacturing Company have added to their universal cutter and reamer grinder an attachment consisting of index centers mounted upon a properly arranged slide and adapted to grinding formed cutters, reamers, taps and similar tools where it is desired to grind on the cutting faces of the teeth.

It is held in place by a single clamp-screw. Lateral adjustment of the work is by the lever *B*, and the reciprocating movement of the table is by the hand wheel *A*, which moves a pinion and rack. The other adjustment—for depth, size of work and wheels etc., is by moving the spindle head. The clamp *C* locks the table in any desired position, while the stop *D* (also adjustable) limits its motion. Work up to 4⅜ inches diameter, 10 inches long, can be ground, and with raising blocks, up to 8 inches diameter.

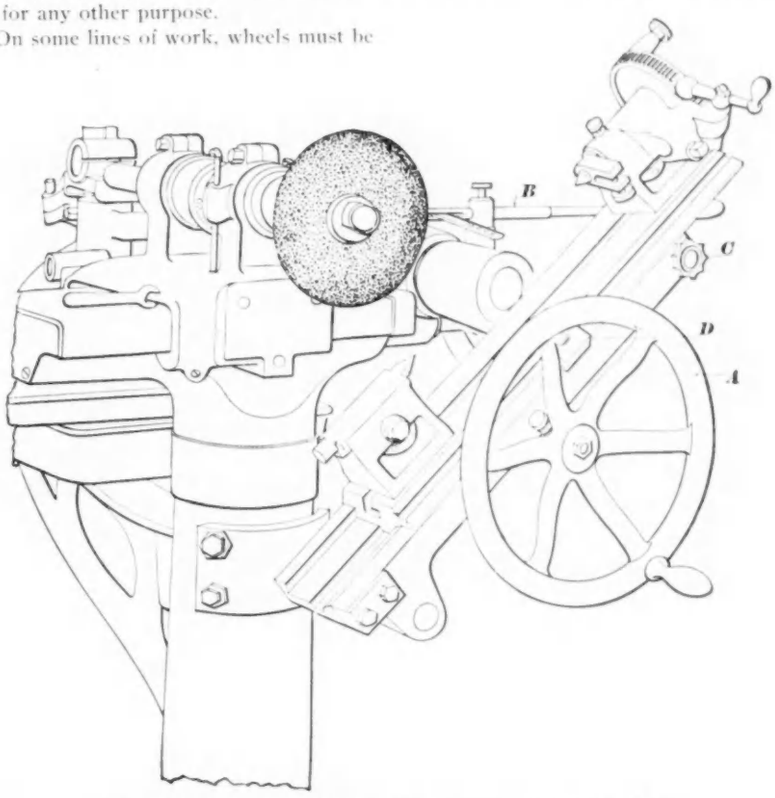
An Improved Polishing Frame.

We give with this an illustration of a polishing frame which, though it looks much like others, has a novel feature that, on many lines of work at least, is important. The arbor is not continuous from one side of the machine to the other, but is divided at the center, and there are two 4-inch pulleys for one 4-inch belt; which can be so placed as to drive both pulleys and both arbors or either one while the other is standing for a change of wheels, or for any other purpose.



AN IMPROVED POLISHING FRAME.

On some lines of work, wheels must be changed often, and, ordinarily, when one man must change his wheel, the other man must stop work while it is being done, which is not the case with the machine illustrated. It is made by Perkins & Co., Grand Rapids, Mich.



ATTACHMENT FOR GRINDING FORMED CUTTERS, ETC.

A correspondent of the London "Times" declares that general cultivation is of greater value to the head of a great industrial establishment than is scientific knowledge. As a proof of this, he instances the late Eugene Schneider, founder of the great Le Creuzot Iron Works, in France, who was not an engineer or metallurgist, and who deliberately gave his son and successor a classical, in preference to a technical, education. "Scientific advice," adds the correspondent, "can be purchased. You cannot at any price buy the sound judgment and ready resource which are the results of a truly liberal education."

Whatever else may be said for this, it is at any rate a novel way of viewing the matter.

A Shop Incident.

The following narrative will interest many of our readers and it carries its own lesson. The incident did not occur in the United States, but human nature and mismanagement are both found even here:

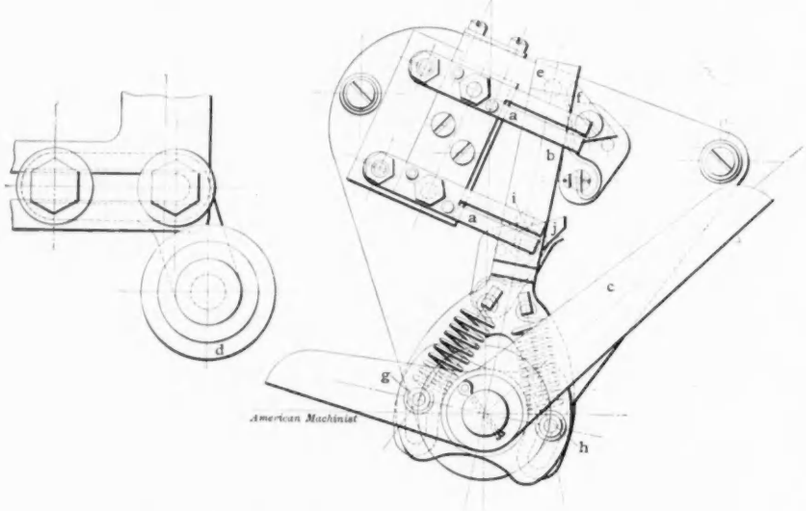
A dispute, it seems, arose between two foremen in a workshop in which the one who was proved to be in the wrong fared badly. Disgusted at the exposure of some neglect of duty, he vented his wrath on a subordinate. It was a rule in the establishment that oil should not be used by the workmen for cleaning their hands, and as the foreman passed through the workshop he caught a delinquent in the act of wiping his hands on some cotton waste. That was enough! The offender was then and there discharged, without any opportunity being afforded to him of explaining his conduct, although it could have been proved that he had been engaged in helping a fellow workman to lift an oily detail onto his machine. He happened to be a skilled artisan, thoroughly experienced in milling machinery, and usually careful in his supervision of the cutters, thereby saving many pounds in the course of a year, although he was only on laborer's pay. His place was taken by a novice who had never worked a milling machine, nor, indeed, seen one, and who had to be taught by his mates how to set to work and handle the machine. The course of tuition turned out very costly, for as soon as he was thought competent to perform a simple piece of work on his own account he was left to his own resources and made some false move by which "a dozen teeth were ripped out of the milling cutter." This involved the loss of the cutter and the spoiling of the work, resulting in a considerable pecuniary expense to the employers. One blunder was followed by another until the damage done by the new and raw hand reached a very serious figure. The foreman subsequently admitted his responsibility for the series of accidents, and owned that his hasty action had been prompted by the excitement of the moment of his altercation with his fellow-foreman. But the confession was a little tardy; the mischief had been done and could not be repaired; moreover, the foreman himself was in a position of practical irresponsibility, for the manager of the works knew nothing of the business. He was a boy who had just left school, and was appointed to his berth because he was the son of his father—the managing director. As the only person qualified to draw attention to the accidents and their cause was the foreman himself, naturally the young gentleman was kept entirely in the dark.—"Machinery," London.

ELECTRICAL MACHINERY.

The Snap Limit Switch of the Sprague Electric Elevator.

We illustrate herewith a new design of automatic snap switch which is applied to the Sprague electric elevator to prevent over-winding. It contains a new feature, intended to make it positive in action.

In all safety appliances which only operate occasionally, there is a liability that when wanted they will refuse to act, from the moving parts sticking together in a manner which is familiar to all our readers. In the case of an electric switch this tendency is increased by the sparking to which they are liable, which not only roughens the surfaces, but may even lead to there being an incipient weld formed between the surfaces, by which the effect of the spring to open them may be successfully resisted.



THE LIMIT SWITCH OF THE SPRAGUE ELECTRIC ELEVATOR.

In the present switch this tendency is overcome by the application of a positive mechanical force, by which the movement of the contact surfaces is begun, whereby, should the surfaces be stuck together, they will be loosened, and be put in condition such that the spring will open the switch without failure at the point decided on.

The spring jaws of the switch are shown at *a a*, the moving arm *b* being in the closed position. The lever *c* opens the switch as will be described shortly. This lever is engaged by the roller *d*, which is carried by the bracket shown, this bracket being carried by the moving rope-driving crosshead of the machine. The switch is attached to the frame of the machine, and the roller is so adjusted as to engage the lever *c* when the crosshead has reached the desired limit of travel. The arm *b* carries a pin *e*, which, in the normal closed position of the switch, is behind the spring latch *f*.

As the roller *d* moves to the right, it engages the arm *c* and depresses it. The moving switch arm *b* is divided below and has two slots whose ends bear upon the pins *g h*, carried upon a plate driven by the rockshaft to which *c* is attached. The slot ends in the switch arm are held in contact with the pins by the springs, both of which are under tension with their lower ends hooked around the pins.

As the arm *c* is depressed, pin *g* ascends, and thereby lifts the switch arm. This movement, by starting the contact surfaces, overcomes any sticking. The upward movement of pin *g* also reduces the tension on the left-hand spring, while the descending movement of pin *h* increases the tension on the right-hand spring, by which it endeavors to open the switch, but is prevented from doing it because of pin *e* and latch *f*, until the switch arm has been raised by pin *g* to a point where pin *e* can pass over latch *f*, when the switch opens with a snap.

The closing movement is an exact counterpart of the opening movement, the pin *i* and latch *j* acting in the same manner as *e* and *f*. The purpose of the action, as applied to the closing movement, is to insure the sudden action of the spring by which the contact surfaces are driven into deep and perfect contact. The spring latches *f* and *j* being swiveled, they offer no resistance to the reverse movement of the switch arm, latch *f* giving way to the left-hand movement and *j* giving way to the right-hand movement.

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The Ball Nut of the Sprague Electric Elevator.

We present herewith an engraving of this very bold device, whose success appears to be commensurate with its boldness.

Its principle is, of course, the same as a ball bearing, but with the difference that in a simple bearing the raceway of the balls is in a circle which returns upon it-

self, and so provides a closed path for the balls.

In the nut, the path of the balls is a screw which does not return upon itself, and an outside path must be provided to take the balls from the delivery end of the nut and return them to the entry end. This path is composed of a hole drilled lengthwise of the body of the nut, and a pair of bent tubes connecting the hole described to the end threads of the nut.

The construction of this nut is such as to delight a mechanic's eye. This will be understood when we explain that the nut is of steel, hardened and ground in the threads by a special and unique grinding machine designed for this purpose, and which we expect to illustrate in a future number.

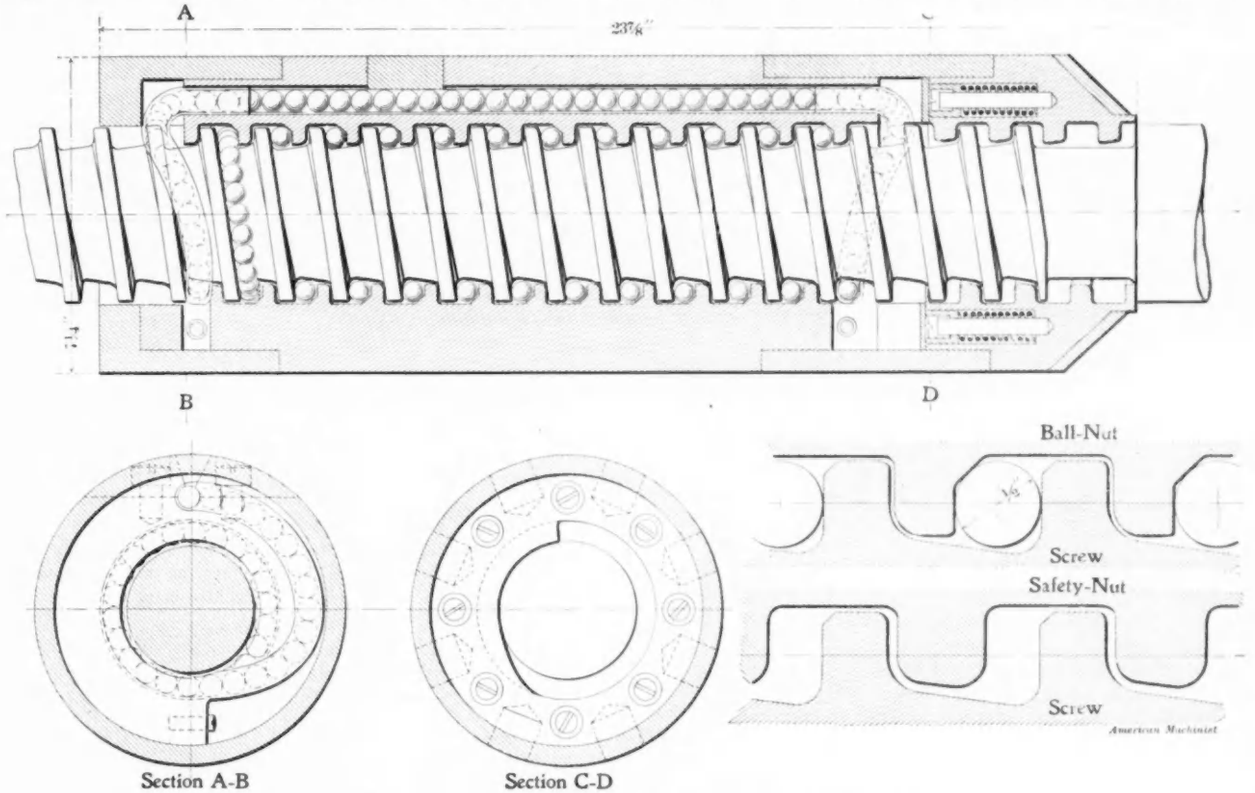
There are several properties and features of this nut which are taken advantage of in a most ingenious manner. It will be understood that this elevator operates in the same manner, so far as the rope gear is concerned, as the hydraulic machine; that is, wire ropes pass from the car up over the sheaves at the top of the shaft, then down to the basement and over multiplying sheaves. The action is essentially similar to a block and fall reversed; that is, the power is applied to the fall and the load to the free end of the rope. The "fall" is attached to a crosshead sliding on a long iron frame, the crosshead being driven by the screw and nut of which we give an illustration—the screw being driven when hoisting by an electric motor. The introduction of balls in the nut largely reduces the friction, of course, and thereby reduces the tendency of the nut to turn. This reduction is, in fact, so great that it is found to be unnecessary to provide any means for preventing the nut from turning, beyond the friction of the nut against its seat on the crosshead—this seat fitting the tapered end shown at the right. This feature is made use of to form a safety device to prevent over-winding. A switch is provided to open the circuit automatically in case of neglect by the attendant; but the feature described forms a double safety, in accordance with the design of the elevator, by which two safety devices are provided at every danger point. It will be seen at once that should the safety switch fail to work, the car will continue to ascend until the nut bottoms at the end of the thread of the screw, when it will simply revolve with the screw—slipping at the joint with the crosshead, and, of course, stopping the car.

Another interesting feature is the safety nut at the right, which is intended to stop the motion of the crosshead in case the car should from any cause get stuck on the ways in descending. In such a case, if the crosshead were not stopped, the cables would at once become slack and invite disaster. In normal action the threads of the safety nut are out of contact with the threads of the screw. Between the safety and ball nuts, however, are interposed several powerful helical springs which are held in compression by the working strain. Should, however, the load upon the cable slacken from any cause, the springs would at once force the two nuts apart, when the safety nut would engage the screw like a lock nut, the two nuts would revolve with screw, and no more cable would be paid out.

In all these actions it will, of course, be understood that the screw drives the nut during the lift of the car only. During the descent of the car the nut drives the screw—an action which, again, is possible by reason of the reduction of friction by the balls.

In connection with the increasing interest in ball bearings for all purposes, it may be of interest to know that the pressure allowed in this nut per ball ranges between 50 and 125 pounds. The balls are ½ inch in diameter. Some signs of wear appear at first while the balls are forming a path for themselves in the screw threads, after which the wear is nominal. The outside diameter of this screw is 4 inches and its pitch is 1¼ inches.

A study of this piece of mechanism will be well repaid, and will serve to show, again, how large a share of purely mechanical design is involved in electrical work.



THE BALL NUT OF THE SPRAGUE ELECTRIC ELEVATOR.

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Electrical Tests of Power Required by Metal-Working Machinery at the Navy Yard, Washington, D. C.

REPORTED TO THE "AMERICAN MACHINIST" BY PROF. O. G. DODGE, U. S. N.

NOTE—In the following tests of boring mills, readings were taken when cutting from the first one only. The readings

from the first machine give figures for a considerable range of feeds, and by adding the net amounts of power for the cuts to the readings for the larger machines when not cutting, figures may be obtained for the probable power for these machines when cutting.

VERTICAL BORING MACHINE.

The Pond Machine Tool Co.; diameter of table, 8 feet; speed of countershaft, 180 revolutions per minute; speeds of cone shaft, in seven steps, from 90 to 360 revolutions per minute; motor belted to 30-inch (largest) cone pulley on countershaft:

Starting torque of cone shaft, in gear, in lbs. ft	98.3
Starting torque of cone shaft, out of gear, in lbs. ft	125.2

Running Machine Idle, In Gear.

	A.	V.	Elect. H. P. Absd.	Mech. H. P. Output.
Lowest speed	14	78	1.45	.53
Middle speed	16	79	1.68	.73
Next to highest speed	18	78	1.87	.93

Running Machine Idle, Out of Gear.

	A.	V.	Elect. H P Absd.	Mech. H. P. Output
Lowest speed	16½	80	1.76	.8
Middle speed	27	76	2.74	1.8
Next to highest speed	46	68	4.17	3.27

CUTTING TESTS.

In Gear, Lowest Speed, Cutting 8 Feet per Minute.

	A.	V.	Elect. H P. Absd.	Mech. H. P. Output.
Running machine, idle	16	83	1.77	.8
Cutting—				
1 tool, ¼-inch cut, ⅜ feed	21	80	2 24	1.33
2 tools, ¼-inch cut, ⅜ feed	24	78	2.48	1 60
2 tools, ¼-inch cut, ⅛ feed	31	80	3.31	2.40
1 tool, ¼-inch cut, ⅜ feed	26	80	2.77	1.87
2 tools, ¼-inch cut, ⅜ feed	34	81	3 67	2 80

Cutting low steel; weight on bed about 100 lbs.

Out of gear, and belted for highest speed, it would require a 7½-horse power motor to start this machine. A motor of this size would otherwise be unnecessarily large.

VERTICAL BORING MACHINE.

The Pond Machine Tool Co.; diameter of table, 10 feet; speed of countershaft, 195 revolutions per minute; speed of cone shaft, in seven steps, from 81 to 468 revolutions per minute; motor belted to 30-inch (largest) pulley on countershaft:

Starting torque of cone shaft, in gear, in lbs. ft	98.3

Running Machine Idle, In Gear.

	A.	V.	Elect. H. P. Absd.	Mech. H. P. Output.
Lowest speed	16	85	1.81	.86
Middle speed	17	84	1.90	1.00
Next to highest speed	19	79	2.00	1.07

Running Machine Idle, Out of Gear.

	A.	V.	Elect. H. P. Absd.	Mech. H. P. Output.
Lowest speed	17	84	1 90	1.00
Middle speed	26	82	2.84	1 93
Next to highest speed	42	73	4.09	3 20

Load on bed, about 100 lbs. No accurate determination could be made of the power necessary to start this machine, out of gear, as a starting bar had to be used. Belts will otherwise slip and run off.

VERTICAL BORING MACHINE.

The Pond Machine Tool Co.; diameter of table, 12 feet; speed of countershaft, 180 revolutions per minute; speeds of cone shaft, nine speeds in regular steps, from 90 to 360 revolutions per minute; motor belted to 33¾-inch pulley (next to largest) on countershaft:

Starting torque of cone shaft, in gear, lbs. ft	223.

Running Machine Idle, In Gear.

	A.	V.	Elect. H. P. Absd.	Mech. H. P. Output.
Lowest speed	17	82	1 86	.93
Middle speed	22	78	2.29	1.34
Third from highest speed	25	80	2.67	1.73

Running Machine Idle, Out of Gear.

	A.	V.	Elect. H. P. Absd.	Mech. H. P. Output.
Lowest speed	31	73	3 02	2.07
Middle speed	57	68	5.17	4.27
Third from highest speed	73	69	6.72	5 80

Load on bed, about 3,000 lbs.; starting torque, out of gear, not determined.

NO. 10 HORIZONTAL BORING, MILLING AND DRILLING MACHINE.

Bement, Miles & Co.; motor belted to cone shaft when moving table, and to countershaft when running drill:

Moving Table Longitudinally, Transversally and Revolving. No Load on Table.

	A.	V.	Elect. H. P. Absd.	Mech. H. P. Output.
Highest speed of cone shaft, out of gear	31	73	3.01	2.07

Running Machine Idle.

	A.	V.	Elect. H. P. Absd.	Mech. H. P. Output.
Low speed of cone shaft, intermediate gear	19	76	1.72	.93
High speed of cone shaft, intermediate gear	30	72	2.88	2.00
High speed of cone shaft, out of gear	67	61	5.45	4.53

PLANING MACHINE.

Betts Machine Co., 96-inch planing machine; bed, 20 feet long by 7 feet wide; planes 96 inches wide and 96 inches high; cutting speed, 12 feet per minute; return speed, 3 to 1; countershaft speed, 250 revolutions per minute; motor belted to countershaft; load on bed, 15 tons:

Readings.	A.	V.	Elect. H. P. Absd.	Mech. H. P. Output.
Driving countershaft with machine belts on loose pulleys	19	67	1.69	.73
Running machine, idle—				
Forward	20	65	1.73	.80
Instant of reversal for return at 3 to 1	95	45	5.70	4.93
Return at speed	30	65	2.60	1.73
Instant of reversal for forward movement	75	55	5.50	4.60
Cutting tests—steel—				
⅛-inch cut, $\frac{1}{80}$ feed	34	76	3.45	2.53
¼-inch cut, $\frac{1}{80}$ feed	37	74	3.65	2.73
Running machine, idle	20	76	2.03	1 57

The cutting tests were made on a duplicate machine, with a load of 12,600 pounds on the bed.

PLANING MACHINE.

Betts Machine Co., 48-inch planing machine; bed, 15 feet long by 3 feet wide; planes 48 inches wide and 48 inches high; cutting speed, 9¾ feet per minute; return speed, 3 to 1; motor belted to countershaft; load on bed, about 4 tons:

Readings	A.	V.	Elect. H. P. Absd.	Mech. H. P. Output.
Cutting ⅛ inch cut, $\frac{1}{16}$-inch feed	24	79	2.53	1.6
Instant of reversal	41	73	3 99	3.07
Return at speed	30	77	3 08	2 13
Instant of reversal	35	75	3.50	2 53

PLANING MACHINE.

Wm. Sellers, 84-inch planing machine; length of bed, 15 feet; cutting speed, 18 feet per minute; return speed, 3 to 1; motor belted to countershaft:

Readings	A.	V.	Elect. H. P. Absd.
Driving countershaft and loose pulleys	16	105	2.25
Driving planer bed, no load	18	105	2.52
Reverse	85	79	8.95
Return at speed	20	107	2.85
Reverse	45	95	5.70
Load on bed 12,600 lbs—			
Driving planer bed, forward	20	106	2 83
Reverse	95	76	9 63
Return at speed	30	107	4 28
Reverse	45	98	5.88

▲ ▲ ▲

Letters from Practical Men.

Another Good Job Without Tools.

Editor American Machinist:

In the June 18th issue of the "American Machinist" there appears a description, by Mr. T. Hodgson, of a job of boring and turning 10-foot sheaves in a shop which to the casual observer would not look capable of turning out anything larger than a 4-foot pulley.

I myself happened to be in Truro at that time while on a visit to my native town a few miles distant, and, being a machinist, I naturally gravitated toward the "Foundry," as the establishment is locally called. While there I saw the same job in all the various processes of molding, boring and turning as described by Mr. Hodgson.

Visiting the same shop about a year later, I saw a job being performed in a manner which for originality I don't think I have ever seen beaten. Approaching the front door I saw a steel converter about 8 feet high and 5 feet in diameter, made of cast iron, with trunnions about 10 inches in diameter and 18 inches long, cast on each side. The first of these trunnions was in process of being turned. The front door opening was about 9 feet wide and about the same height. The door posts were of about 10 x 12 timber, for lumber used to be cheap in that part of the country. At the center of the height of the door these posts were bored with a 2-inch hole through each. On the front side a wrought-iron plate tapped 2 inches, and on the back a similar plate bored with a 2-inch hole through the center, were bolted with four bolts, the large holes in the plates corresponding with the holes in the posts. Through these plates steel screws, pointed to act as centers, were placed with a jam nut on each. On these centers the converter was swung on its trunnions. A gear about 3 feet in diameter, having its hub bored slightly larger than the rough diameter of the trunnion, had previously been placed. This gear had four set screws set at equal distances

around each end of its hub, and by means of these it was trued up on the trunnion. A pinion to match this gear was placed on a shaft mounted in boxes set on a timber frame, so that the gear and pinion meshed properly, and the opposite end of this shaft carried a pulley through which it was driven; while a slide rest, similarly blocked up on timbers, was doing the turning on the opposite trunnion, and doing it in a manner that would compare very favorably with the work of some lathes costing hundreds of times as much as his rig did.

GEO. F. WADDELL.

Butte, Mont.

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A Blueprint Frame.

Editor American Machinist:

I inclose a sketch of a blueprint frame and truck devised by Mr. Spencer, of the Fairbanks Scale Company, for printing extra large plans now required by their foreign trade.

The truck is made of ½-inch gas pipe, which will be found stiff enough for a glass 36 x 48 inches. At each end of the truck, at the top of the "A," is a special casting bored out to form a bearing for a trunnion, one of which is attached to each end of the print frame. This is shown in Fig. 3. At one end of the frame is a plate containing several holes in a semi-circle, and in the special casting is a spring pin which will drop into whichever hole will give the proper angle to the print frame.

The frame is loaded by turning it bottom up, as in Fig. 2, when the cross-bars may be unlatched and thrown back. Each of these cross-bars carries several springs, shown in Fig. 4. These consist of a post screwed into the wood, a cylinder sliding freely upon it and pushed out by a coiled spring, the play being limited by a pin and a slot.

The pressure may be regulated by turning the post into or out of the wood as required, and in this manner the pressure may be equally distributed over the entire surface of the glass, so that the details in the middle of a large tracing will print as sharp and distinct as on a smaller drawing.

W. H. SARGENT.

St. Johnsbury, Vt.

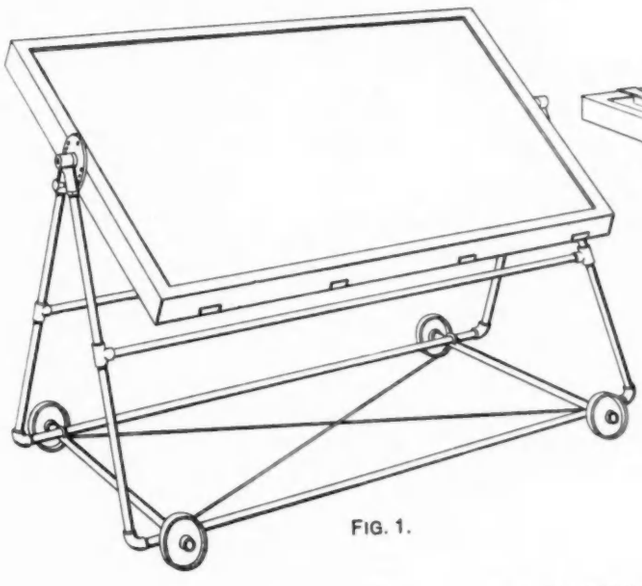

FIG. 1.

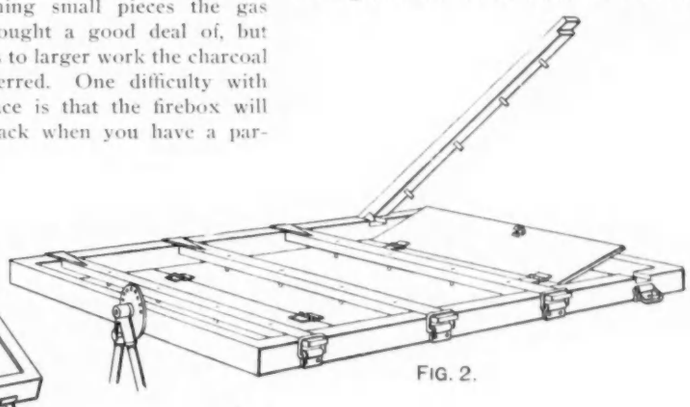

FIG. 2.

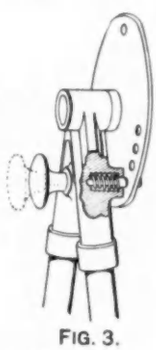

FIG. 3.

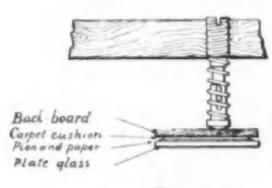

FIG. 4.

A BLUEPRINT FRAME.

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Hardening.

Editor American Machinist:

An article in your issue of September 3d, concerning hardening by means of gas, and signed by A. P. Press, has come to my notice, and, being a practical tool and die maker myself, I wish to place before the readers of the "American Machinist" some facts connected with it.

For hardening small pieces the gas furnace is thought a good deal of, but when it comes to larger work the charcoal forge is preferred. One difficulty with the gas furnace is that the firebox will sometimes crack when you have a particular piece in the furnace. The gas immediately comes in contact with the hot steel and eats into it, injuring it permanently. Again, the air is too much in contact with the steel, which makes it spotted, as if peppered and salted. Some kinds of steel will flake in a gas furnace before it reaches an overheated condition. I lay this fact to the effect of the air and escaping gas upon the metal. This contact with the air also makes it very hard to get an even heat with a piece of any size.

I find that charcoal gives a uniform heat, and the piece is not exposed to air and gases, as in the case with the gas furnaces. Even if charcoal does cost 33 cents per bushel, is it not better to have something reliable, which can be used in five minutes' time, rather than something that is not reliable, and for which you must wait fifteen or twenty minutes? Charcoal also tends to hold the carbon in the steel, while gas tends to burn it out.

Hard coal is sometimes used and gives very satisfactory results. This is cheaper than charcoal and far ahead of the gas furnace.

F. L. HUBBARD.

▲ ▲ ▲

That Novel Compound Engine.

Editor American Machinist:

You seem to have a wrong impression of the construction of my engine. This engine has two crank disks (the wrist pin connecting the two), and each running in a recess in the side plates. There are packing rings inserted in grooves in the outer edge of the crank disks, which spring out against the inside surface of recess, making these joints steam-tight. The connecting rods have grooves lengthwise, with packing strips inserted, and with light springs under them to hold the packing in light contact with the side walls of the steam chambers and face of crank disks. The pistons also have similar packing strips.

Please look this over and see if you have not done me an injustice in your opinion given in the "American Machinist" of September 10th.

W. C. KELLY.

Hastings, Mich.

[We did know that the design contemplates packing strips at the sides of the connecting rods; but from our observation of similar arrangements used in oscillating piston engines, we think it would be difficult to keep these strips tight. We were not informed about the use of sup-

plementary crank disk. That device would undoubtedly much lessen steam leakage; but still, we think we do the engine and its inventor no injustice when we say that such an engine would probably be difficult to keep steam-tight. This is only our own opinion, however, and the engine is before our readers, who can judge of this matter for themselves.—Ed.]

▲ ▲ ▲

Power Required to Groove Rolls.

Editor American Machinist:

I notice in your issue of September 17th a query from a correspondent in York, Neb., as to the power required to corrugate chilled iron rolls.

I believe this question can be more definitely and accurately determined by a statement of the work performed in our shops [Dubuque Turbine & Roller Mill Co.] by the Graham hydraulic corrugator, than by the method adopted in your answer. The machine I refer to is provided with eight cutting tools, arranged concentrically in a movable die, which is operated by a hydraulic piston. Eight complete grooves or corrugations are cut for each upward stroke of the piston.

The diameter of the piston is 20 inches, and the pressure varies from 20 pounds for light work to 40 pounds for the heaviest work the tools will stand. The calculation of the power required would therefore be as follows: Area of piston $\times$ pressure per square inch $\times$ feet per minute = foot pounds, or $314 \times 40 \times 3 =$ 37,680, or 1.14 horse-power for eight tools. If you take one-eighth of this it will give you .142 horse-power for each tool. For the ordinary corrugations, such as 16, 18, 20, etc., it will take only about half the above amount of power.

F. Thornely.

Dubuque, Iowa.

[The machine referred to by Mr. Thornely undoubtedly shows pretty nearly the actual force required to do the work. We recognized that the method used by us could not give very accurate results, but it was the best that suggested itself at the time.—Ed.]

▲ ▲ ▲

Square Versus V-Slides on Shapers.

Editor American Machinist:

Recently we were in the market for some new machine tools, and among others purchased were two shapers.

In bargaining for these we were led into quite extended arguments with certain makers as to the comparative merits of square and V-slides on the ram of the shapers. The gist of it was, they seemed to prefer to make, and strongly advocated our buying shapers with V-slides, their reason being that they were cheaper and were just as good, if not better, than the square slides.

As we reasoned that the square slides would give us the most wear and work easier, besides being more easily repaired, and probably stronger, we insisted on this style of machine.

It seems to us that if the surface of the V-slide should in time wear, say, .002 inch, the ram, on account of the angular shape of the slide, would have nearly .004 inch play. This would not be so with the square slide, as .002 inch wear would mean just .002 inch play, and no more; all this provided the wear was not taken up, of course.

It is also our belief that it requires less power to drive the square slide ram on a heavy cut than it does the V-slide, on account of the tendency of the V-slide to wedge up, as it were. Another point in favor of the square slide is that it takes less oil to lubricate it than the V-slide, which, being on a side hill, allows the oil to run off nearly as fast as put on.

Now, as the shaper manufacturer wrote us that out of over 4,000 shapers which he had made and sold, less than 2 per cent. of them had square slides, we wish to inquire why we are in the minority. Are we right or wrong in our reasoning? Look at it as we may, we still believe V-slides on a shaper is very poor mechanics, even though there are 50 to 1 against us, according to this maker.

Will someone who is interested, or has studied the question, give us the benefit of their experience? We would like to see the matter discussed, as the subject is well worth while.

F. C. McClary.

Utica, N. Y.

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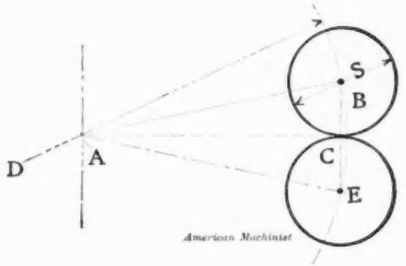
Diameter of Ball Bearings.

Editor American Machinist:

Following is a formula for determining the diameter of the circle passing through the centers of balls in a ball bearing, having given the diameter and number of balls, providing the balls have no space between them, *i. e.*, are tangent to each other. I have found this formula very useful, and having never seen it printed



DIAMETER OF BALL BEARINGS

thought it might be useful to some of the readers of the "American Machinist":

$$D = \frac{S}{\sin. \frac{180}{N}}$$

in which

D = diameter of centers of balls;
S = size of balls;
N = number of balls.

The formula was deduced as follows: In the figure, the line $B\ E$, connecting the centers of two adjacent balls, passes through the point of tangency of the two balls, which is at C, and drawing $B\ A$ and $E\ A$, we have the triangle $B\ A\ E$. $B\ C$ being equal to $E\ C$, we have the right angle triangle $B\ C\ A$ with the right angle at C:

$$\text{Sine of angle } B\ A\ C = \frac{B\ C}{A\ B} \qquad (1)$$

It can be readily seen that the angle $B\ A\ E = \frac{360^\circ}{N}$, N being equal to the number of balls used in the bearing:

$$\text{Angle } B\ A\ C = \text{angle } E\ A\ C = \tfrac{1}{2} \text{ angle } B\ A\ E = \frac{\frac{360^\circ}{N}}{2} = \frac{180^\circ}{N} \qquad (2)$$

Substituting in equation (1) we have

$$\text{sin. } \frac{180^\circ}{N} = \frac{B\ C}{A\ B} \qquad (3)$$

$$B\ C = \frac{S}{2} \text{ and } A\ B = \frac{D}{2}$$

$$\frac{B\ C}{A\ B} = \frac{\frac{S}{2}}{\frac{D}{2}} = \frac{S}{D}$$

and substituting in equation (3) we have

$$\text{sin. } \frac{180^\circ}{N} = \frac{S}{D} \qquad (4)$$

and by reducing the equation to find the value of D we have

$$D = \frac{S}{\text{sin. } \frac{180^\circ}{N}}$$

in which

D = diameter of the center of balls;
S = size of balls;
N = number of balls.

Arthur B. Babbitt.

[The same formula has been used for computing the pitch diameter of gears by the system of chordal pitch.—Ed.]

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A Working Test of a Threaded Piston Rod.

Editor American Machinist:

The tests shown by Mr. Bullock, in the "American Machinist" of June 25th, giving the breaking strength of several methods of fastening crossheads to piston rods, do not appear to me to have any practical value, for in this case it is the elastic and not the ultimate strength that is wanted. It is a well-grounded rule in the construction, adjusting and running of machinery, that a load that will permanently change the shape of any part ought never to be applied. If a jam nut is screwed up so that the pressure between it and the crosshead is less than the elastic strength of the rod, as it always should be, then a pull that will stretch the rod permanently will free the nut from the crosshead. Hence, the jam, nut when properly adjusted, has no influence on the ultimate strength of the rod.

In order to get a sort of a snap shot at a jam nut, as one might expect to find it when in use, I had sections of a rod and crosshead made as shown in Fig. 1. The nut and crosshead were tapped with

a standard 2-inch tap, and the rod threaded to fit them so that it could be screwed in by hand. I then put the crosshead in a vise, screwed the rod into it just 3 inches, and then set the jam nut up as shown in Fig. 2. A weight up to 115 pounds was gradually applied to the wrench, 54 inches from the nut. The weight included the weight of the free end of the wrench. The rig was then put in the testing machine, and the rod very slowly pulled on; at the same time a man was trying, with his hands, to unscrew the nut, and just as a pull of 50,000 pounds was reached he succeeded in doing so. There was no perceptible change found in the rig after it was removed from the machine.

This test shows that the actual pressure

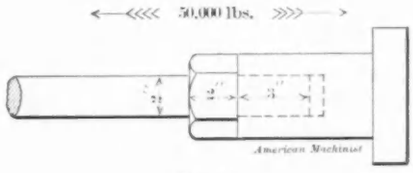

Fig. 1

between the nut and the crosshead was very close to 50,000 pounds, while if all the force applied to the wrench could have been concentrated there, it would have been equal to $54 \times 2 \times 3.14 \times 115 \times 4.5$, which is 175,940. These figures show that 72 per cent. of the weight applied to the wrench was lost in friction.

The letters that have recently appeared in the "American Machinist," giving various methods of fastening the crosshead to the piston rod, appear to me to be good examples of the extremes in engine de-

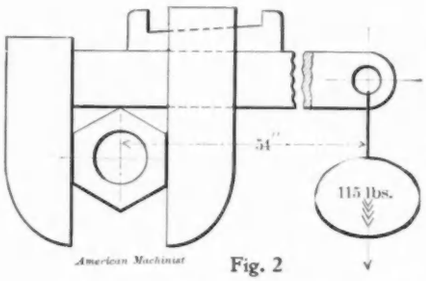

Fig. 2

TESTING A PISTON ROD.

tails. On the one hand, take Mr. Bullock's method. He tapers, threads and plugs the crosshead ends of the rods. This is certainly a difficult and expensive way of making the attachment, and would be found to be especially so if a crosshead had to be duplicated by others than the builder. I have no doubt but that Mr. Bullock's crossheads are "O K," but it is well enough to remember the poor fellow who may have trouble in running them.

On the other hand, Mr. Halsey's method is simplicity itself. He leaves the rod straight and forces the end against the bottom of the hole in the crosshead with a key. Anyone in the machine business ought to be able to duplicate either part of this without any difficulty. In a high-speed engine with a crosshead whose center of gravity does not correspond with the center of the piston rod, as the Laird crosshead (which is largely used on locomotives), then the side-jerking that it must get at each end of the stroke might prove that Mr. Halsey's method lacked rigidity, but it would only be under such circumstances that any trouble would occur.

J. H. DUNBAR.

Youngstown, O.

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The Late Mr. Holloway's Foundry Management.

Editor American Machinist:

The tribute paid to the late J. F. Holloway, in your issue of September 17th, vividly recalls to my memory the incidents you have described, and which were such as to cause all his employés to show great respect and love for an employer rarely if ever equaled. There are few if any employers who have endeared themselves more to those under their charge than did my friend, Mr. Holloway. Though not in the habit of saying much, and very careful of his expression, his actions secured for him the implicit confidence of all who worked for him. He made all, from his highest assistants down to the commonest laborer, feel that they had in him a true friend. While somewhat reserved in his manner, yet he was always easily approached by anyone. He seemed to take more pleasure in talking to those below him than to those more nearly his level. He delighted to feel that he had encouraged or aided anyone in need or in trouble, especially if the recipient were ignorant of the source of his help. The numbers who are indebted to him for acts of kindness will never be known. He ever assisted and encouraged energy, merit and talent to their highest achievements, and many owe success in their undertakings to his true manhood, the writer being one of them.

Although a brilliant practical engineer and able manager, he was one of the most unassuming men to be found, and was always ready to impart any information in his power to aid the progress of mechanism. He was a most careful follower of all details as well as the general plans of any work coming under his charge. His mechanical ability and skill were admired by all who had any cause to be brought into contact with his management. The manner in which he directed the construction of massive machinery with inadequate and poor tools, was often a marvel to mechanics and engineers. Work can be easily done with good tools, but it requires brains to do it without them. He took a most earnest interest in all departments of his plant, and on several occasions expressed to the writer that he considered the foundry offered more scope for mechanical skill and good judgment than any other department of mechanics. He fully recognized the uncertainties and difficulties of heavy founding, and stood ever ready to render his foremen any assistance that could aid them in turning out good castings. This was one of the factors that enabled the Cuyahoga Foundry to run for ten successive years without loosing one single large casting—a record I have not seen excelled. When Mr. Holloway passed from us, the founders lost a valuable friend; one who ever stood ready to assist in elevating the molder's art to the highest plane of mechanics.

THOS. D. WEST.

Sharpsville, Pa.

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Centering Both Ends at Once.

Editor American Machinist:

An astonishing number and variety of special appliances have been gotten up, at one time or another, or in one shop or another, for use in connection with the engine lathe. The demands of special jobs have generally first suggested them, and when they have been made they have frequently been found more widely and constantly available than was first expected of them. It is quite rarely that these devices are failures for the purposes for which they are made, and many of them are so good that they get in use on other lathes in the shop of their nativity, and later on we find them in quite general use in other shops.

The "American Machinist" has done a great service in spreading the knowledge of such devices and promoting their general adoption, and is still doing much in the same direction. As with other fields of invention, however rapidly we may traverse it, we never can approach the time when we may say that the inventions are all made, and that the inventor has no more worlds to conquer. The reverse is everlastingly the case, and there are always more inventions and discoveries before us to be made to-day than there were yesterday.

I find myself thinking just now of one special device for the lathe that is not in general use, but which I cannot but think would be generally useful. To tell all about it and bring it in where it belongs, I had better tell how I first came to use it. Once upon a time, then, I was running pretty steadily a 24-inch lathe. Although the shop was a good-sized one, I did not have the hum-drum life of it that a fellow would have if he was running such a lathe in a big shop to-day. I had a great variety of work, and I had, after a while, a great many special things for doing it, and no objection was ever made to my making as many such things as I wanted. They were generally made without any help from the drawing room. I could go to the blacksmith or to the pattern shop with a little sketch and get what I wanted, and,

before anybody knew, it was all done and at work helping things along. Of course, that free-and-easy style of running a shop would not do now, but I really believe that it worked very well with me.

Although I had quite an interesting variety of work, with special novelties coming along at intervals, I had also certain jobs that used to come around over and over again with considerable regularity. One of these jobs will be understood well enough from the little sketch that I show here, Fig. 1. It was a short and chunky wrought-iron shaft with a couple of enlarged places on it. The sketch is intended to show the forging about as I used to get it, and also the finished shaft that it was my job to dig out of it, as the sculptor

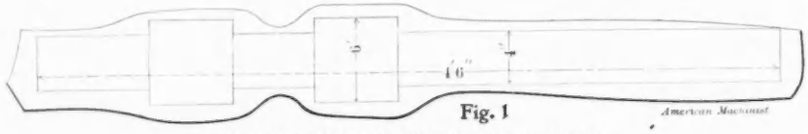

Fig. 1

THE FINISHED SHAFT IN THE ROUGH.

carves the statue from the rough block of marble.

I do hope that I have got the shade lines right on this drawing, for I certainly have tried to. To tell the truth, I am only really certain about the left-hand end of the forging. That, of course, ought to have the heaviest kind of a shade line on it, and there it is. About the lower side I am a little in doubt, because it makes a little difference, I suppose, whether a thing is round or square, and there are some people, I believe, who say that round or cylindrical boundaries are not entitled to shade lines. This forging was not round enough to be certain about it, so I gave it the benefit of the doubt and the benefit of the shade line, and the character and individuality of the sketch is greatly promoted by it. The finished shaft, shown inside the forging outline, was, of course, not entitled to shade lines, because at the time I am speaking of it had not been turned, and consequently had never been exposed to the light.

The "forgings," as the sketch is intended to suggest, were admirable specimens of the forgeman's art, the art in this case consisting in putting into each forging as much iron and as little labor as the customer would accept without "kicking," and this customer was no "kicker." The shafts were not round or straight; the ends may have been clipped off at a single blow, and they were left just as the chisel left them. The shafts were of excellent iron, so that it was a pleasure to work it.

I never had one of the shafts that would not clean up, but on account of their being so crooked it required the most careful centering generally to get them out. We had a centering machine, but it would have been no good in this case, because the ends never could be allowed to run true. I believe I did put temporary centers in the first shaft on the centering machine, just to be able to square up the ends to pretty near the right length, or, rather, to cut off the ends, for I have actually had to cut off an inch or over from each end of the shaft, and, of course, I thought then, as I have thought many times since, how much more valuable and serviceable a centering machine would be if it had a squaring-off arrangement as a part of it, to bring the piece to the right length and the end to an approximately flat condition before using the center drills. Such a machine would, of course, cost much more than a simple centering machine, and it ought to, because it would be worth so much more.

The temporary centers made in the centering machine were, of course, all gone when I got the ends of the shaft cut off, and then, after considerable time had been used up, I was only just ready to begin the centering. I had already had to change ends with it in the lathe, in order to face both ends, and the running on the temporary centers had given me a little idea about the direction to throw the new centers, and the distance to throw the centers, and that was all I had gained so far. The shaft was of such a weight that it was a rather ugly thing to handle, and I am talking now about the time before the chain hoist, or at least of a place where the chain hoist had not yet taken hold. The shaft forging weighed very close to 300, and the finished shaft only a pound or two over 200. I had

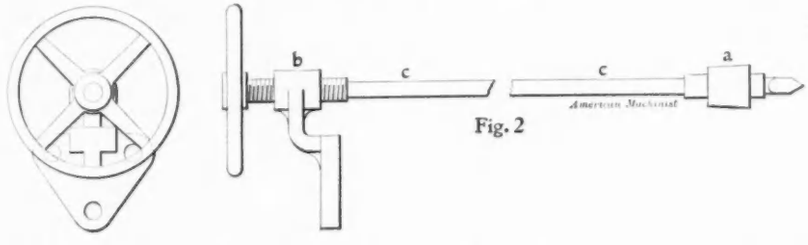

Fig. 2

somebody to give me a lift to get it up onto the lathe, and then I had to go it alone. Of course, I had a block with a swiveled V and an elevating screw to it, so that I could change ends with the shaft without much trouble.

Well, after the temporary facing to the length and chipping off the hubs, I attacked the ends of the shaft with a center punch, and then got it onto the centers, and after two or three trials with a knob of chalk I had the centers where I wanted them; and with a drill socket in the live spindle and a center drill, I soon had the shaft so that I was ready to go to work.

It was only the first one of those shafts that I handled in that way, and when the next one came along I went at it differently. I was fortunate enough to have a good chuck to the lathe—a strong, independent, four-jawed chuck, about as big as the lathe would swing, and I had a steady rest with a big opening in it, which is another good thing to have. I found around the shop a sleeve big enough to go over the big part of the forging, with four set screws in each end to true it up and hold it fast.

I have done all sorts of silly mechanical things, and once I made one of those sleeves with three screws on each end instead of four, saved drilling and tapping two holes and making two screws, but I only did it once. If anybody has tried centering anything with three screws he will know just how it is himself. With four screws it is the simplest thing in the world. You find out which way you want the thing to go, and you slack the screw on that side and tighten the opposite one, and it is done. But with three screws you find which way you want to go, and you slack that screw, and you immediately don't know where you are at. Of course, with three screws, when one is tight on the work all are tight, but this advantage is fully offset by the nuisance that when one is slack all are slack, and as likely as not the thing turns around on you and you have to begin all over again. The three-jawed chuck is, generally speaking, a nuisance, except as a universal chuck. I have no use for a three-jawed chuck with independent jaws if I can get a four-jawed chuck.

But the sleeve that I had on this job had four honest screws on each end. I put the sleeve on the big part of the forging and laid it in the steady rest, and caught the long end of the forging in the chuck. I did not waste much time in getting the shaft true; just trued it up in a rough way by my eye, which is not such a rough way, either. Then I cut off the end of the shaft with the strongest cutting tool I had, and it did not take long to do it.

That was all that I had to do to that end. Then I caught the faced end of the forging in the chuck and set the sleeve on the long end, and then I had the job just where I wanted it. It was now in order to true the thing up carefully, just as I wanted it to run on the centers, and so that I could be sure that every spot would turn out. I don't need to say anything about that, because any fellow can do it. Then I tightened up the chuck

screws and the screws of the sleeve, and was ready to go to work. I faced off the long end of the shaft the same as I did the other, leaving about $\frac{1}{32}$ inch to face off of each end after the job was all done.

Of course, with all lathe work turned on the centers there should be a good center all the time the work is being done, and there should be good centers left in the job after it is finished, so that if anybody of a future generation has to put it in the lathe again he will not be cursing his ancestors because they left no centers. There is nothing that so cheapens a lathe job and "gives away" the inferior lathe hand like bad ends on his work. A disgusting thing that I see sometimes even now is a little ring right around the center that has been taken off with a flat file, because the side tool did not go quite down the center.

If the center is large enough for the job, there is not generally any objection to leaving a thin finishing cut to be taken off the end of the shaft after the job is done. The truth of the center will not be affected and the job will have a better finish, and I finished my shaft in that way.

After the shaft was faced off to the right length, with enough left to skin off the ends after the other turning was all done, I drilled the centers in both ends of the shaft without slacking a screw, and how I did that is really all that I set out to tell about at this time. Of course, I had a good drill chuck with a taper shank to fit the center holes in the lathe spindles, and a good stock of drills. I drilled the outer center of the shaft with the drill chuck mounted in the tail stock spindle, and the shaft revolving, and I drilled the center in the back end of the shaft with my back-action live spindle drill, shown in the sketch, Fig. 2.

The live spindle was hollow, of course, as a live spindle ought to be, and before I put the forging into the chuck I slipped into the center hole the bush *a* as a guide for the drill spindle. At the back of the lathe I had fastened a little bracket *b* with three $\frac{3}{8}$-inch cap screws. This bracket generally stayed on the lathe, but it could be taken off at any time if it happened to be in the way. The hub of the bracket was true with the center of the spindle of the lathe, and it had a left-hand thread 10 to the inch. When I wanted to drill the center I only had to pick up the drill spindle *c*, with the taper-shanked, left-handed drill in the socket in the end of it, screw it into the bracket until the point of the drill began to cut, the lathe, of course, running all the while, and when the drill began to cut I could tell, by counting the turns of the hand-wheel how deep to drill the center. The center drill was ground to cut left-handed.

I need not tell any old hand that this back drill spindle is a handy thing to have, but I have never seen anyone use it. It may sometimes be used for other drilling besides center holes, or in chuck work small reamers may be shoved in from the back. If the tools used cut right-handed, the lathe must, of course, be run backward when they are used. I think the left-handed thread for the bracket and spindle is better than a right-hand thread, as it will then feed against the drilling when the lathe is running ahead, and if anything catches, the drill will not be drawn into the work.

TECUMSEH SWIFT.

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Screw Propeller Designing.

Editor American Machinist:

I have just seen Mr. Chase's book on "Screw Propellers," and ask that gentleman's pardon for correcting the statement on page 60, viz.: "It is very doubtful whether there will ever be devised a formula that can universally be applied to determine the best form and the most advantageous dimensions for a screw propeller under any given set of conditions."

I worked out such formulæ three years before Mr. Chase's book appeared, and the fact was noted in the English nautical papers about August and September, 1892. The announcement brought me many requests to design propellers, which requests have continually increased; thus sufficiently proving the usefulness of my system in increasing speed and saving coals.

There may not, however, have been any announcement of my system in America; hence, Mr. Chase may not have heard of it.

C. PURCELL TAYLOR,
Bart., D.Sc.

London, England.

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Lubricants and Anti-Lubricants.

It has taken mechanics a long time—at least some mechanics—to learn to fully appreciate the function of the lubricant as a part of any running machine. That the oil in the journal box is not an expedient of a more or less extraneous character, a device merely to stop squeaking or to prevent heating, but really an actual and necessary part of the complete machine, just as the connecting rod is a part of a steam engine, or as a gear is a part of a clock, some of us have been slow to learn. And yet this is not far from the actual position that the lubricant should be understood to hold. Machines may perhaps run for a time with no lubricant, just as a man may work minus an eye or an arm; but the machine or the man can neither of them do their all-around best, the days of their running will be shortened, and their product will be defective in quality or in quantity, by reason of their incompleteness.

That we have been learning something in this line anyone can realize who has any memory. It is not so long ago that oil cups first came into general use, and then only for the principal parts of an engine, and when one-half of the duties of an engineer consisted in running about with an oil can and squirting the oil here and there as his ear or his hand should suggest the application. We strayed into an up-to-date engine room the other day, and there, if the engineer had any portable oil can, it was not in evidence, every rubbing surface discoverable upon the engine being provided with some means of automatic and continuous lubrication.

And now another rather strange thing arises. Those who have had such a hard time of it learning to respect the lubricant and its functions have not yet learned equally to respect in its place the anti-lubricant. In the successful operation of machinery the anti-lubricant is perhaps as important as the lubricant. It is in some places in machinery quite as necessary to secure the adhesion of surfaces as in other cases the easy slipping of surfaces in contact is desirable. The power realized from a given system of driving is often the resultant or remainder after deducting for loss of adhesion at one end of the system, and for too great friction at the other end of it. In cases of belt driving the increase of adhesion by tightening the belt often causes increase of friction in the journals, and so the gain of power by that means has its offset of loss.

The condition of the surface of the pulley, and of the belt in contact with it, can scarcely be said as yet to have received the attention that it should have received. The too common history of any given belt drive is first a computation of the surface required for the power to be transmitted, and then the providing of a sufficient surface if other conditions were satisfactory, with an ignoring of those conditions and then a slipping belt, with all that it implies. How often it happens that an iron pulley with a polished face, in combination with the hard, dry surface of a new belt, fails entirely to do the driving expected of it, and then, as the oil can used to come into requisition when the journal squeaked, the rosin comes in to make the belt stick. Of course, the rosin is a brutal and temporizing device, where no device should have been required. A smooth iron surface is more suggestive of slipping than of adhesion, and it is hard to make anyone possessed of any true mechanical instincts believe that it is the best possible surface for the purpose. We have indeed the best possible evidence that it is not. It is notorious that the faces of the wooden pulleys, that of late years have come into such general use, give better adhesion than iron pulleys. And then there are the pulley doctors that go around the country, curing slipping belts by covering the pulleys with paper or canvas, or something similar, on which the belt will stick. The pulley coverings that cure slipping belts, would seem to belong to the pulley at the beginning of its existence, instead of being adopted when everything else has failed.

The time should also come when the belts sent out by the belt makers should not be absolutely unfit for the use that they are made for until they have received such treatment as renders them no longer respectable in appearance. A belt that has simply been made capable of driving would sell for not more than one-half the cost of the new belt, which shows how much is not known about belting.

The operation of covering an iron pulley with canvas is a simple one, and anyone should be able to do it. The face of the pulley is first to be thoroughly cleaned, and then washed with muriatic acid. The canvas should be cut long enough to go twice around the pulley, and the same width as the face. Soak it in some good liquid glue, and then carefully wrap it around the pulley in the same direction as the pull of the belt is to come, smoothing the last end down nicely, and letting the pulley stand at least twenty-four hours before using. Of course, the pulley may not look as pretty as before, but it will do two or three times the work.

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A New Universal Milling Machine.

We present herewith four views of a new universal milling machine which has some points of interest.

The features aimed at by the designer were:

1st. Increased range of movement of the cutter.

2d. Facility for the use of face cutters for many jobs on which slabbing cutters have heretofore been used.

3d. Adjustment of the head laterally with the work, in order to bring the cutters up close to the spindle bearing, regardless of the position of the cut.

The first three views show the main spindle in three positions, and illustrate the range of adjustability of the spindle. Fig. 1 shows the spindle in a vertical position. A butt mill is shown in use; but it is plain that ordinary surfacing, such as is usually done with a slabbing cutter, can be done with the spindle in this position, and, in fact, this adjustment shows the position in which such surfacing is ordinarily done. Fig. 2 shows the spindle in the usual horizontal position, with a cutter similar to the last; while Fig. 3 shows the head in an angular position, in which it becomes useful for a variety of work.

The method of driving is shown in Fig. 4. The cone pulley shaft drives an intermediate shaft parallel with the line of the feed, by means of bevel gears, and this shaft in turn drives the main spindle through a similar pair of gears. The head which carries the spindle swivels around the center line of the intermediate shaft, thereby permitting the movement shown without interfering with the driving mechanism.

The head will be seen to be mounted on a stiff ribbed beam which is gibbed to the top of the frame column, and is adjustable lengthwise of the beam. This adjustment of the beam enables the cutter to be on a short arbor and close up to the main bearing, even though the cut being made is upon the further side of the carriage. To permit this movement of the beam, the cone pulley shaft is splined and slides freely through the cone. The spindle will be seen to be provided with a watch lathe pattern of chuck.

The machine is the design of Mr. C. E. Van Norman, of the Waltham Watch Tool Company, Springfield, Mass. The machine shown is of small size, having been so designed as to be within the capacity of the tools of the shop; but larger sizes are to be placed upon the market.

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We have an inquiry for a grinding mill suitable for pulverizing hardwood sawdust at the rate of a barrel a day. Does any reader know of such a mill?

Solution of Cubic Equations.

BY GEORGE B. GRANT.

The solution of the equation of the fourth degree, in a recent issue of the "American Machinist," may have scared some, as the editor expected; but some others were not only not scared, but called for more of the same sort. There was really nothing about it to scare anyone not afraid of work, and anyone who is afraid of $\sin p = \sqrt[3]{n}$ is not likely to be meddling with this matter at all.

That these troublesome equations are of frequent occurrence in practical computation I know, and I know that the usual text-book on algebra is nearly useless for solving them, and, as the work must be done, the question is only as to the best method for that purpose.

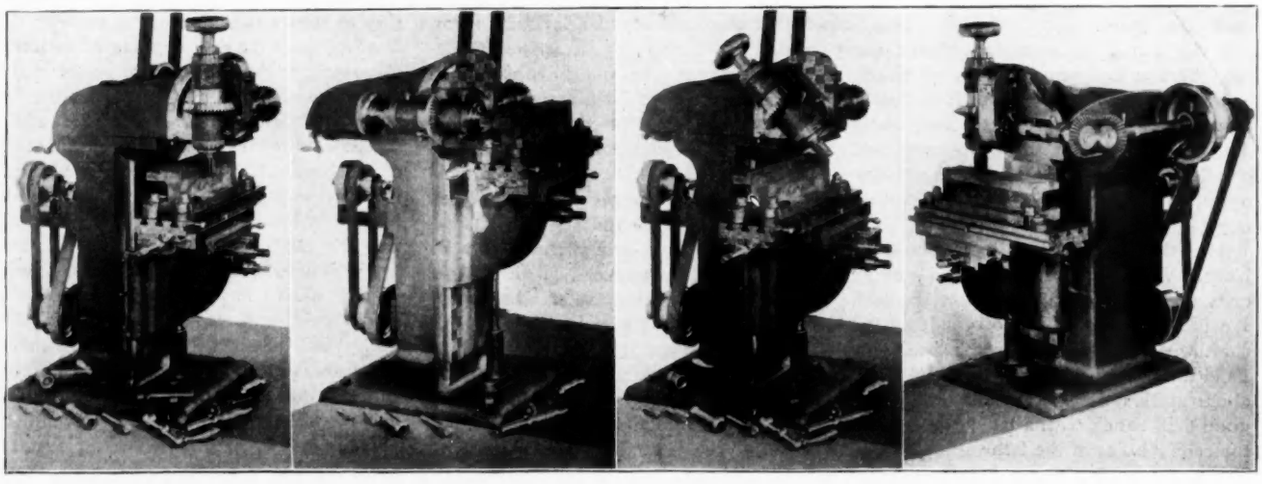

Fig. 1. Fig. 2. Fig. 3. Fig. 4.

VAN NORMAN'S UNIVERSAL MILLING MACHINE.

If the algebra is consulted, the first thing noticed is that part of the equation, its second term, is assumed to be missing; but, unfortunately, it is not missing in the case in hand. After learning how to discard that term a solution may be reached; but, as likely as not, it will only appear that algebra is of no use for the purpose, as no direct process is known. Certain approximative methods known as Sturm's Theorem, and Horner's Method are provided for the purpose; but they are so fearfully and wonderfully constructed that it will take five times as long to learn them as it will take to guess at the solution off-hand. Sturm's and Horner's rules are such brain-racking devices that guesswork is preferable; for, although they are admirably adapted to the simple integral cases chosen to illustrate them, they are ill-suited to the decimal fractions real cases are sure to present.

What is needed by the engineer and the practical computer is a working rule and not a demonstration. He always knows how to make simple substitutions in algebraic formulæ but has no time for special

processes, which, no matter how elegant and ingenious they may be, are objectionable, because they must be learned anew for each application.

The requirement that no special knowledge or study shall be necessary, has been kept in view in the following solution of the cubic equation, and anyone who can work with the common logarithmic tables can apply it to any possible case without further study.

Take the full cubic equation:

$$x^3 + a\,x^2 + b\,x + c = 0$$

First compute the three quantities:

$$H = +\frac{b}{3} - \frac{a^2}{9}$$

$$K = +\frac{a^3}{27} - \frac{a\,b}{6} + \frac{c}{2}$$

$$N = +\frac{H^3}{K^2}$$

Any numerical example will fall under one of three different cases, according to the sign and value of N.

Case 1—When N is any positive quantity, or when it is a negative quantity and numerically less than 1, such as $+7.$, or 0, or $-.9$, the equation has but one real root, and that is given by the formula:

$$x = +\sqrt[3]{K}\left(\sqrt[3]{-1+\sqrt{1+N}}+\sqrt[3]{-1-\sqrt{1+N}}\right)-\frac{a}{3}$$

an expression that is very easily applied with the assistance of a table of square and cube roots.

Case 2—When $N = -1$, as will occasionally happen, the equation has three real roots, two of which are equal. The two equal roots are:

$$x_1 = x_2 = +\sqrt[3]{K} - \frac{a}{3}$$

and the other root is:

$$x_3 = -2\sqrt[3]{K} - \frac{a}{3}$$

Case 3—When N is negative and also numerically greater than 1, such as -1.02, or $-9.$, the equation has three real and unequal roots, and a little simple work with the logarithmic tables is required.

First, find the angle D from

$$\sin. D = \sqrt{-\frac{1}{N}}$$

and then get $\pm\frac{1}{3}D$, and make it $+$ if K is $+$, or $-$ if K is $-$. Then compute the three roots from

$$x_1 = +2\sqrt{-H}\sin.\frac{1}{3}D - \frac{a}{3}$$

$$x_2 = +2\sqrt{-H}\sin.\left(60^\circ - \frac{1}{3}D\right) - \frac{a}{3}$$

$$x_3 = -2\sqrt{-H}\sin.\left(60^\circ + \frac{1}{3}D\right) - \frac{a}{3}$$

The computer must take pains to keep the $+$ or $-$ signs correct, which matter will take care of itself if it be understood that the sign is as much a part of a quantity as one of its numerals, and must be written each time. Too often the computer will write 942 and depend upon remembering that it is -942, when he would never write it 42 and depend on remembering the 9. Really, the $-$ sign is as essential as the 9.

Example 1—First take an equation with simple integral co-efficients, because, although such a case never comes up in practice, it is easier to work and is a better illustration than an actual case.

Take $x^3 - 9\,x^2 + 20\,x - 12 = 0$ We have $a = -9$, $b = +20$, $c = -12$, and

$$H = +\frac{20}{3} - \frac{81}{9} = -\frac{7}{3}$$

$$K = \frac{-9^3}{27} + \frac{180}{6} - \frac{12}{2} = -3$$

$$N = -\frac{7^3}{3^5} = -1.41157$$

As N is negative and greater than 1, the example belongs to Case 3, and

$\sin. D = \sqrt{.708455}$, $D = 57^\circ\ 19'\ 10''$ and $\frac{1}{3}D = -19^\circ\ 6'\ 23''$, using the $-$ sign because K is $-$.

Then we have the three roots

$$x_1 = +2\sqrt{\frac{7}{3}}\sin.(-19^\circ\ 6'\ 23'') + 3 = -1 + 3 = +2.$$

$$x_2 = +2\sqrt{\frac{7}{3}}\sin.(60^\circ + 19^\circ\ 6'\ 23'') + 3 = +3 + 3 = +6.$$

$$x_3 = -2\sqrt{\frac{7}{3}}\sin.(60^\circ - 19^\circ\ 6'\ 23'') + 3 = -2 + 3 = +1.$$

Example 2:

$$x^3 - 5\,x^2 + 16\,x - 30 = 0$$

$$H = +\frac{23}{9},\ K = -\frac{170}{27},\ N = +0.421004$$

and we have case 1, for one root

$$x = -\sqrt[3]{\frac{170}{27}}\left(\sqrt[3]{-1+\sqrt{+1.421004}}+\sqrt[3]{-1-\sqrt{+1.421004}}\right)$$

$$+\frac{5}{3} = -\frac{1}{3}\sqrt[3]{170}\,(+.57696 - 1.29900) + \frac{5}{3} = +\frac{4}{3} + \frac{5}{3} = +3$$

Example 3, the kind that occurs in practice:

$$x^3 - 9.339\,x^2 + 8.5513\,x + 33.9608 = 0$$

$$H = -6.8403,\ K = +.1230,\ \tfrac{1}{3}D = +0^\circ\ 7'\ 53''$$

$$x_1 = +\ .011995 + 3.113 = +3.125$$

$$x_2 = +4.5239\ \ + 3.113 = +7.637$$

$$x_3 = -4.5359\ \ + 3.113 = -1.423$$

The equations of the third and fourth degrees are the only ones treated, because that of the second degree needs no explanation. The equations of the fifth degree, and higher, have never been solved by any direct process, and, in fact, there exists an incomprehensible proof by Abel that they cannot possibly be solved. For such cases Strum's Theorem, and other forms of guessing, are the only known methods, and it is fortunate that they are but seldom needed.

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The Fair of the American Institute.

It is difficult to see how anyone can attend the American Institute "Fair" now open at Madison Square Garden, in this city, without a feeling of regret over a wasted opportunity. A generation ago the annual exhibitions of the American Institute were of great interest and value. They presented a wide variety of the latest and best in mechanical, industrial and artistic achievement. For many years these exhibitions seem to have steadily degenerated, until at the present standing they would seem to be beyond all hope of recovery. No exhibition has been given since 1892 until this year. Those that have been skipped have not been missed, and the present is inferior to any of its predecessors.

The main floor is occupied principally by nickel-in-the-slot machines, phonographs, "take your picture in a minute," and other catch-penny Coney Island devices. The merry-go-round is absent, although ample room could be found for it. In connection with these things many standard concerns, of course, exhibit goods that may be found in the stores; but scarcely a thing is to be found in the entire exhibit that is not familiar or easily within the knowledge of all well-informed people.

The basement of the building is a "Machinery Hall." A very smooth-running Weston engine drives a line shaft, and seven or eight machines were running at the time of our visit. As several machines were being set up, and others were standing around in crates, it seemed probable that the machinery exhibit would be considerably increased, and on a later visit we may find something interesting there.

Madison Square Garden is becoming noted for its annual exhibitions, each in its turn drawing its crowd of well-satisfied visitors. There is no apparent reason why the American Institute Fair might not be made as attractive as the best.

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The locomotive building plant, the machinery for which was purchased of American tool builders and to which we referred some time ago, has been shipped from Philadelphia, and it is now reported that the Russian Government has practically closed negotiations for the plant of the Wellman Steel Works, at Chester, Pa., the price mentioned being $86,175. This concern has been in the hands of a receiver for some time past, but it is understood that all legal and other objections have been removed, and the purchase includes engines, a large train of rolls, cranes, pumps, etc.

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The Educational Department of the Young Men's Institute, 222 Bowery, New York City, opened October 5th, and, as in previous years, gives young men opportunities for instruction in Steam Engineering, Electricity, Drawing, Shorthand and other branches, under very favorable conditons. It is an excellent opportunity for mechanics, engineers and others living in New York and who seek advancement.

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The General Electric Company inform us that a man calling himself Charles C. Caldwell, formerly of Shelbyville, Ind., is representing himself as an electrical engineer connected with the General Electric Company, and drawing small sums against the company and its officials. The man has never been connected with the General Electric Company in any way.

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Politics and Business.

Our commercial report contains this week a letter written by a machinery manufacturer, in which he states that two of his acquaintances, of opposite political faith, had each declared his intention of starting up his shop in November if his particular party were successful at the polls.

It may be that the American people will in November adopt such a policy as will be ruinous to business and manufacturing interests. We do not believe they will; but if we attempt to convince ourselves that both the manufacturers referred to are right, such a policy of ruin is inevitable, because it will result from the election of either candidate or the indorsement of either platform. This puts us in rather a peculiar, not to say ridiculous predicament, and leads us to inquire if it is not better to remember that, while participation in political affairs by every American citizen is inherently and traditionally right, it is well to avoid letting such participation interfere with our personal efforts to secure business and keep things moving.

We all know that times are hard and that the volume of business that can possibly be secured is less than usual; but as a result of considerable attention to and study of the matter, with perhaps unusual facilities for observation, so far as machinery establishments go, we can state as a positive fact that those establishments whose proprietors are taking their politics rather coolly, and are never devoting one hour of time to politics that can be advantageously spent in hustling for business, either here or abroad, are having much the best of the situation, almost without exception.

We are perfectly well aware that some lines of business cannot be forced or pushed much, if at all, under present conditions; but, on the other hand, we know of different establishments in precisely the same line, some busy as can be, others apparently almost moribund; and, so far as we can discover, the only possible reason is that some are pushing for business and getting their full share of what business there is, while others are simply letting present opportunities slip by them because they fear something is going to happen.

We are not attempting to teach business to business men, but are simply presenting a few cold facts that are significant, and that might profitably form a subject of careful study in some quarters.

Especially do we wish to call attention to the fact that America is no longer the entire world to an American machinery builder; that it is especially advantageous to have markets in other countries, in which business can be done when times are slack here, as experience shows they occasionally will be. The business of our machinery builders in foreign countries is rapidly increasing; and until they have made a thorough trial, few American builders are justified in concluding that they cannot get their share of it.

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Getting the Benefit of Our Inventions.

Mechanics and engineers—in the larger meaning of those designations—are, more than most men, so situated as to see the means by which, and the manner in which, human progress is accomplished. We see inventions and improvements in constant succession applied to all industrial operations, giving every producer a continually increasing efficiency. We can scarcely avoid at times some thinking ahead along the line of the possibilities suggested. Inventions and improvements, as applied to production, are too often thought to mean merely the cheapening of the product. They certainly always mean that, but with the result, not that we get the same amount of product for less money, or what money represents, but that we get a greatly increased amount of product for the same money, and the distinction is well worth bearing in mind. One condition, if accepted, means overproduction, or under-consumption, which are identical; while the other condition means a full realization of the benefits secured to the producer.

A pertinent illustration we have in the development of artificial lighting. In perhaps no field of invention is our progress and advantage more fully shown than in the difference between the tallow candle and the whale-oil lamp of only fifty years ago and the various brilliant lights of to-day. There are those now who, if they had lived in the days of the tallow dip, and if they could have foreseen the possible marvels of illumination now so universally realized, would have assured the world that at the close of the nineteenth century our lights would only cost us, say, one-tenth what they did then. Probably the fact to-day is that to each individual the actual relative cost to him, or the proportion of the cost of the lighting that he now enjoys to the total cost of his living, is as great to-day as it ever was, but that for this same cost the same individual gets ten times as much light, and vastly more than ten times the light, that he had in the "good old times."

The amount of artificial light that we can use, or that we can have glowing around us, is practically unlimited; but the same is not true of all the products of our industry. It is not true generally of the so-called prime necessities of life. It is not true of our food or of our clothing. The civilized man can eat no more, and probably less, than the savage, if he can get it, and, as the human body has not grown perceptibly larger, it takes no more to cover the new man than it did the old, so far as the weather is concerned. Where the savage could spend his life in the quest of his food and his clothing, and then was all too familiar with hunger and cold, the mechanic of to-day can earn in one half hour of his day sufficient food and clothing to effectually ward off hunger and to keep him from shivering in the blast. If he were content to have merely the same for less cost, instead of more for the same cost, he should be happy in these days; but it is to the honor and for the progress of the race that he is neither altogether happy nor perfectly contented. Our food must not only be sufficient in quantity, but it must be constantly better in quality and variety, and must change with the round of the seasons. Our clothing must be not merely a single garment or suit that we must wear as long as it will hang together, but must be something of positive comfort, and minister to our pride of person and to the pleasure of those we meet. Any man in these days who is without the desire for better food and better clothing, to begin with, a better house to live in, and the larger and fuller life that opens to the view of us all, who is not desiring these things, nor reaching out for them and grasping them as they successively come to his reach, is to be pitied and to be deplored.

The drag and the curse of our modern life is the non-consuming producer. He may be the Chinese laundryman or he may be the skilled workman who pours his earnings into the saloon. Sometimes he may even be the one who is priding himself on his accumulations in the savings bank, and there are others of various

grades of non-consumptive inefficiency who do not get all that they might out of their lives, or help as they might to maintain the balance so necessary to both stability and progress. The aggregate effect of our individual habits has more to do with the symmetrical adjustment of our collective life than any legislation can have. The greatest boon that legislation can confer is to allow Nature and human nature as free action as possible.

The engineer, the inventor, the machine constructor, are continually augmenting human opportunities, and it would seem that they should also give some thought to the conditions under which these opportunities may come to their complete fruition.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(175) W. T. C., Chester, Pa., asks: In a triple expansion engine, with a constant load and constant steam pressure, will not the work done by the low pressure cylinder be increased by giving it a later cut-off? A.—The contrary is true. The work of the low pressure cylinder will be increased by giving it an earlier cut-off. The change of the cut-off will have a twofold effect. The earlier cut-off will increase the receiver pressure and also the back pressure in the intermediate cylinder, so that the work done by the intermediate cylinder will be diminished, but the work of the low pressure cylinder will be increased to about the same extent, the increase of pressure more than compensating for the reduction of volume. As the same weight of steam passes through the low pressure cylinder in either case it is not difficult to see that the higher initial pressure will do more work.

(176) Student, Richmond, Va., writes: Please explain the workings of the oil engine valves. How is the letting into the engine of such a small quantity of the oil at a time accomplished, and how is the air drawn into it in just the exact quantity? A.—The special device employed for delivering the oil varies with the different makes of engine. In the Hornsby-Akroyd engine a pump runs constantly which is capable of delivering the largest charge ever required, and a ball governor works a by-pass which operates at an earlier or later part of the pump stroke as more or less power is required, the surplus oil being allowed to flow back to the tank. The air is allowed to fill or nearly fill the entire cylinder for each charge, the volume of air admitted being constant, regardless of the charge of oil. Our correspondent should secure an opportunity to examine an oil engine, and he will then be able to learn more about it than we can well tell him.

(177) A. L. E., Louisville, O., writes: I have some trouble with a duplex steam pump to get it to work well. As soon as we speed the pump over 30 strokes per minute it will lose the water. The dimensions of the pump cylinders are: Steam, 3½ inches; water, 2¼ inches, and 4 inches stroke. I judge that a larger pump would do the work better, for it keeps this pump busy to do the work nicely. A.—We do not know precisely what is meant by the 30 strokes per minute; as the term is used by different persons, it may mean 30, 60 or 120 single piston strokes per minute. The sketch accompanying the letter shows that the suction pipe is 1½ inches diameter, running horizontally 30 feet and then down with a vertical lift of 20 feet for the water. The sketch shows a horizontal vacuum chamber very near the pump, and also another sketch, as a suggestion, with a vacuum chamber at the top of the vertical pipe. The latter arrangement might be preferable; but we judge that the trouble in the case is, as our correspondent suggests, that the pump is too small and has to run too fast, and the suction pipe is certainly too small. A 2-inch pipe would show better results. With an actual lift of 20 feet, it is to be remembered that with a perfect vacuum at the pump there would be less than 6 pounds of atmospheric pressure to drive the column of water in the suction pipe, and it is probable that the pump suction is decidedly less than a perfect vacuum.

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Business Specials.

Transient Advertisements 40 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear wheels, gear cutting. Grant; see page 9.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Gasoline engine castings, ¼ to 5 H. P. Send for particulars. Box 129, St. James, Minn.

Engine Castings ¼ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Presses and dies for bar and sheet metal work. Ferracute Machine Company, Bridgeton, N. J.

Just Issued—Catalog No. 8. Mailed free. Clayton Air Compressor Works, 28 Cortlandt st., New York.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Duplex and special gear cutters, counterbores, cutter and surface grinders, vertical millers, hand punches and shears. R. M. Clough, New Haven, Ct.

Patent Soliciting of High Class.—D. Walter Brown, Counsel in Patent Cases, 111 Broadway, New York. Send for "Brief History of Patent Legislation."

Notice—The dissolution of the George Place Machine Co., through a receiver, in no way affects me or my regular business, as I had no financial interest in the company. My name has never been, nor is it now, on any of its obligations. Owing to the corporate name under which the company has been doing busines, I thought it best to make this explanation. Very respectfully,

GEORGE PLACE.

New York, September 19, 1896.

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As a result of the final trial of machine guns at the Washington Navy Yard, the Colt machine gun has been accepted, and fifty of the new weapons will be ordered for use on naval vessels. In the trial the Colt gun fired 400 shots in 53 seconds, and afterwards discharged 2,111 consecutive shots before overheating. It is understood to be this last performance rather than the high speed for a short time which determined the selection.

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The Naval Chief of Ordnance has, it appears, protested against the award of contracts for torpedo boats proposed to be made on the basis of the recommendation of Chief Constructor Hichborn and Engineer-in-Chief Melville, and this will cause a further delay, probably, in the settlement of the question of who is to build the boats.

It would seem to be one of the simplest and easiest things in the world to change the running of trains on a double-tracked railroad from one track to the other. The Old Colony road up to last year ran its trains on the left-hand track, when it changed them to the right-hand to conform to the practice of the New Haven system, of which it is now a part. The last year's expense account contains an item of $287,305 as the cost of making the change.

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Mr. D. McFarlan Moore, whose system of vacuum tube lighting attracted so much attention at the electrical exhibition last June, reports continued progress with his system. He considers that his light far surpasses any other ever made by artificial means.

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Commercial Review.

NEW YORK, SATURDAY EVENING, OCT. 3d.

REVIVAL IN THE ELECTRICAL TRADE.

The cry "Wolf" in regard to business improvement can always be heard here and there. So long has it been the case that individual instances of good business did not indicate the average of the market, that it has seemed advisable to let the test of time apply itself to the isolated reports of improvement that have been heard of late in various lines of machinery before shouting about a return of prosperity. But affairs have now reached such a stage that the existence of a marked change for the better in the dynamo and motor trade, at least, can be affirmed.

The change may indeed be slight—we have even heard a denial that there is any at all—but we cannot help believing that business is on the move and in the right direction. The case of one of the largest companies may be cited in illustration. They experienced a decrease of trade until recently, and although work enough remained on hand to prevent any great reduction of factory forces they were feeling that they had gotten pretty nearly to the end of the rope as regarded a show of activity. But now new work has begun to come in and things will be able to move along steadily in the future. Improvement is reported by various other concerns in this city. One company is so well satisfied with its business outlook that they are now drawing up plans for the extension of their works.

AMONG THE SEVERAL LINES

of electrical machinery, power motors are in relatively good demand, as they generally are. Their adoption by such local factories as install equipments is said to be universal. The company last referred to above report some two or three hundred per cent. increase in the mill demand (referring to this general class of work), though such figures are presumably exceptional. The indications to be seen in this fact are especially good, because the demand from the mills and

factories is a reliable criterion of business. They say, too, that trade in electrical machinery for this purpose is being pushed out West, which is the field soonest withdrawn from in dull times because payments there are considered less prompt than in the East.

Electric lighting generators are in better requisition than they were some time since, apparently because the season has come when people are making preparation for winter and long evenings.

The trade in street railway electrical machinery is not inclined to be brisk before the election, but companies are hopeful for the business that is to follow. It is said that this is about the time to look for the contracts for next year's work, and that, although this season so far does not compare favorably with the corresponding one of last year, it will do so later on.

Adopting the language of the draughting room, any little betterment which the electrical or other lines of trade which may be experiencing may be stated as follows:

IMPROVED DEMAND EQUALS SEASONABLE ACTIVITY PLUS RETURNING CONFIDENCE.

The two terms in the right-hand member of the equation are unknown quantities, and we can only form a guess as to their relative value. The fact that people are settling down to autumn work and making preparations for winter is doubtless responsible for much of the increase, but a comparison of notes with other lines of trade and finance which are brightening up tends to show that buying is being stimulated by more exuberant spirits.

To have a revival in trade just now is rather a sensible idea, for the number of failures in the United States during the first nine months of this year has been startling. Bradstreet makes the number greater than for the corresponding period of any year since the records have been kept, although less in total of liability than in the first nine months of 1893. The returns compiled by Dun show that the failures have been most numerous among manufacturers.

AS TO EXPORT TRADE,

statements of a favorable nature are heard. A certain house reports that a goodly portion of its foreign business, which is in lighting and power machines, is done with England, and that motors for running printing presses may be mentioned among the sales. One of the largest concerns remarks that its foreign trade is partly with Europe, but notably with the minor countries of the world, among which South Africa and Australia are purchasers of street railway goods. In regard to trade with the Europeans, it is said that we have the upper hand of them in electric railway machinery, etc., as they have of us in philosophical apparatus.

MACHINERY EXPORT STATISTICS.

Exports of machinery from New York, as unofficially computed from September manifests, so far as yet made public, with some delayed from the month preceding, amounted to $632,019, compared with $830,954 for August, upon the same basis of computation. In addition may be mentioned a shipment of locomotives to the value of $49,750 upon a vessel which cleared September 21st for Yokohama. Reports made during the week ending October 3d show items of machinery amounting to $171,247.

POINTS FOR TOOL BUILDERS WHO SEEK FOREIGN TRADE.

A well-known manufacturer of machine tools, who has returned from Europe this fall, has consented to state for us his views upon the foreign outlook for the same. He writes: "Personally, I met with such success that our works are crowded to their utmost capacity, and we are now running day and night, with two shifts of hands. From this it might appear that all one had to do was to go to Europe and demand orders, but such is not the case, as quite a number of American builders can testify. The main point was, that our goods possess merit, and the facts concerning the same were brought before the buyers in the proper manner. (On this latter point much could be written and said.) Primarily, to speak German and French and adapt oneself to the somewhat peculiar habits and business style of the buyer is of great importance." Our correspondent further considers that a fair amount of trade is to be obtained in Europe, Japan, China, South Africa, etc., but that it is necessary to go after it. He also believes that an increased tariff would provoke retaliatory measures, and thus be an injury to the export branch of the machinery business. He cites in illustration a threat heard in Paris, to place on American bicycles a duty of $25 each, regardless of cost, in the event of further tariffs on our part against France.

He proceeds: "In England, American machinery is popular and will sell for some time to come, particularly the medium sizes, such as our line. In large and heavy machinery I do not think much will ever be done. The same applies to France, excepting that France, to my observation, demands simple tools and goes slow on complicated ones like universal milling machines, universal grinders, etc. Neither will the English and French worry us much by excessive copying and low prices, as we now beat them all to pieces in furnishing good goods at low prices. Coming now to Germany, that is the country that will worry us all. While at present they are enjoying a marvelous degree of activity and prosperity, and are buying American tools liberally, it is largely because they are (1st) unable to supply the home demand, and (2d) are buying our machinery to study the same, then possibly

(Continued on page 37.)

Help Wanted.

Situation and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our subscription list, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Wanted—First-class vise hand on small work. Address Lock Box 392, Danbury, Conn.

Experienced mechanical draftsman wants position; best references. Box 91, AMER. MACHINIST.

Wanted—Pos. as foreman boiler maker; have had large exp.; a hustler; A 1 refs. Box 90, AM. MACH.

Expert draftsman, experienced machine designer, open for engagement. Box 73, AM. MACH.

Foundry foreman with considerable experience wants pos.; American; best refs. Box 76, AM. MACH.

Wanted—Thoroughly pract'l mechanical draftsman; give age, reference and wages expected. Address Box 87, care of the AMERICAN MACHINIST.

An experienced designer wishes to change; well up on Corliss and automatic engs., modern shop & office systems; moderate salary. Box 86, AM. MACH.

Machinist, also mechanical draftsman, desires position; will work two weeks free to show ability; German; speaks little English. Box 80, AM. MACH.

Wanted—Position by a thoroughly first-class pattern maker, 15 years' experience; can furnish best of references; age 37; capable of taking charge. Box 89, AMERICAN MACHINIST.

Wanted—Experienced foreman for assembling & finishing dept., making cyclometers, combination locks, etc.; steady employment; first-class refs. required. Address U. S. Mfg. Co., Fond du Lac, Wis.

I would like to hear from party desiring service of thoroughly up-to-date foundry foreman on light or heavy work; if you need such a man, drop me a line and get full particulars; good references. Box 84, AMERICAN MACHINIST.

Position wanted as foreman on screw, milling & drilling machines, automatic or hand; have had charge of sewing machine and bicycle works for 16 yrs.; am expert screw machine & screw tool hand; know how to handle help. Box 85, AM. MACH.

Bicycle Tubing—Wanted—Foreman who thoroughly understands the manufacture of cold drawn seamless steel tubing. To one who is familiar with this trade in all its branches a good position is open. Applications treated confidentially if so desired. Address, with age, reference, salary, experience, etc., Box 88, AMERICAN MACHINIST.

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Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S.M.York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

We offer an exceedingly fine lot of first-class second-hand machinery, lathes, planers, shapers, drills, millers, screw machines, etc. Call, or get list 17 B. The Garvin Mach. Co., 440 Canal st., N.Y.

Wanted—An Idea. Who can think of some simple thing to patent? Protect your ideas; they may bring you wealth. Write John Wedderburn & Co., Patent Attorneys, Washington, D. C., for their $1,800 prize offered to inventors.

Just Published. Two Reliable Books.

"SHOP KINKS,"

By ROBERT GRIMSHAW. Showing special Ways of Doing Work Better more Cheaply, or more Rapidly than Usual.

400 Pages, 225 Illustrations, $2.50.

"THE MODERN MACHINIST," By JOHN T. USHER, Machinist.

320 Pages, 257 Illustrations, $2.50.

☞ *Illustrated circulars of both sent free.*

NEARLY READY.

"GAS, GASOLINE AND OIL ENGINES,"

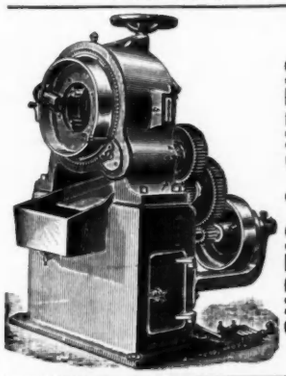
By GARDINER D. HISCOX, M. E.

400 Pages. 200 Illustrations. Price, $2.50.

This book treats comprehensively, and almost entirely of American makes of Gas, Gasoline and Oil Engines, with instructions for the care and management of the same.

Our Catalogues of Books for Machinists, Engineers, Electricians, etc., also sent free.

NORMAN W. HENLEY & CO., Publishers,
15 Beekman Street, NEW YORK.



CURTIS & CURTIS,
66 GARDEN ST., BRIDGEPORT, CONN.

Pipe Cutting and Threading Machinery, FOR HAND OR POWER, RATCHET DRILLS, RATCHET DIE STOCKS AND MALLEABLE IRON PIPE VISES.

Computing Figures

mentally is probably the hardest kind of toil known. The Comptometer makes it easy, is twice as quick, insures accuracy and relieves all mental and nervous strain. Why don't you get one?

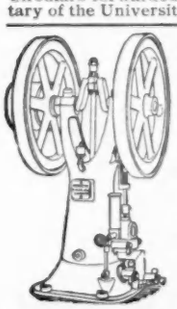
Write for Pamphlet.

FELT & TARRANT MFG CO.
52-56 ILLINOIS ST., CHICAGO.

Columbia University
in the City of New York.

SCHOOL OF MINES,
SCHOOL OF CHEMISTRY,
SCHOOL OF ENGINEERING,
SCHOOL OF ARCHITECTURE,
SCHOOL OF PURE SCIENCE.

Four years' undergraduate courses and special facilities for graduate work in all departments. Circulars forwarded on application to the Secretary of the University.



This beats Wind, Steam or Horse Power.

We offer the

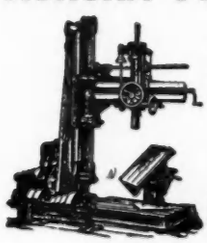
WEBSTER 2 1-2 ACTUAL HORSEPOWER GAS ENGINE

For $150, less 10 per cent. discount for cash. Built on the interchangeable plan. Built of the best material. Made in lots of 100, therefore, we can make the price. Boxed for shipment, weight 800 pounds. Made for Gas or Gasoline.

☞ *Write for Special Catalog.*

WEBSTER MFG. CO.
1079 W. 15th St., CHICAGO.

AURORA TOOL WORKS

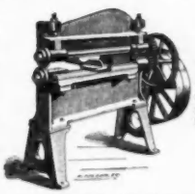


AURORA, IND.,
Builders of Latest Improved
UPRIGHT and RADIAL DRILLS
WITH PATENT
AUTOMATIC STOP.
From 14 in. to 40 in swing.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN.

J. M. ALLEN, President.
WM. B. FRANKLIN, Vice-President.
F. B. ALLEN, Second Vice-President.
J. B. PIERCE, Secretary and Treasurer.

MACHINISTS' SCALES, Patent End Graduation. We Invite Comparison for Accuracy with all others. Every Scale guaranteed. Send for list. COFFIN & LEIGHTON, Syracuse, N. Y



BETHLEHEM ROTARY SHEAR

Will cut Sheet Metal and Plates ¼ inch thick or less, in circles, curves or straight-away, any length, any width up to 31 inches.

BETHLEHEM FOUNDRY AND MACHINE COMPANY,
South Bethlehem, Pa.

FINISHED NUTS

TRUMP BROS.
MACHINE CO.,
.....MANUFACTURERS,
WILMINGTON, - - - DELAWARE, U. S. A.

Patent Carrying Track
OVERHEAD TRAMWAY

for Mills, Foundries, Machine Shops, or for Merchandise. *Send for Book.*

The Coburn Trolley Track Mfg. Co.,
... HOLYOKE, MASS ...

SPECIAL PRESSES AND DIES
FOR ALL KINDS OF BICYCLE WORK.
FERRACUTE MACHINE CO.
New Catalogue. BRIDGETON, N. J., U. S. A.

The Albro-Clem Elevator Co.,

7th St.
and
Glenwood Ave.,
Phila., Pa.

Makers of the
Albro Worm
AND
Worm Gear

Consumes less power and gives better results than any other system. Proofs cheerfully furnished.

(Continued from page 36.)

improve or imitate; so that I fully agree with what a prominent dealer in American machine tools said, that in less than ten years, few, if any, such tools would be exported to Germany. Moral: 'Make hay while the sun shines.' This the writer is going to do as far as possible. Much more could be said on the above items or points, but I can only touch them lightly at this time.

"The long-awaited improvement in demand for machinery in this country has not shown itself yet, in my opinion, and as long as we consider politics of more importance it will not. Just look at this picture: One very prominent and wealthy Democratic manufacturer in our town told me, if Bryan were elected he would instantly open his factory and run full force, but would not if McKinley were elected. The same day a prominent wealthy Republican manufacturer said the same thing, only reversed the names of Bryan and McKinley. Now, what is to be expected? Nothing but chaos. Meantime I am busy and indifferent as to who will be elected, and my policy is simply to hunt business where it at the time exists, if I have to go to the North Pole."

Without having made machine tools a subject of special consideration this week, we have incidentally heard a favorable report from one concern as to the trend of trade.

IRON AND OTHER METALS.

The improvement in the iron market is satisfactorily progressing. It is not a boom, but a healthy demand. Southern pig irons have again been marked up. Considerable demand for Bessemer iron and steel is reported from Pittsburg.

The cut and wire nail makers have reaffirmed prices for October.

An improved demand for iron and steel is reported from Germany, and new works are under way which will increase the production about 20 per cent. Nearly all their pig iron is sold out until the first quarter of next year.

Quotations.

NEW YORK, Monday, October 5th.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$11 75 @	$13 00
No. 2 foundry, Northern	11 25 @	12 00
No. 2 plain, Northern	10 50 @	11 00
Gray Forge	10 50 @	10 75
No. 1 foundry, Southern	12 00 @	12 25
No. 2 foundry, Southern	11 00 @	11 25
No. 3 foundry, Southern	10 50 @	10 75
No. 1 soft, Southern	11 00 @	11 25
No. 2 soft, Southern	10 75 @	11 00
Foundry forge, or No. 4 Southern	10 25 @	10 50

Bar Iron—Base—Mill price, in Carloads, on dock; common, 1.10 @ 1.15c.; refined, 1.20 @ 1.35c. Store prices: common, 1.40 @ 1.50c.; refined, 1.50 @ 1.80c.

Tool Steel—Ordinary sizes, standard quality, 5½ @ 7c.; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—From store, 1.65 @ 1.75c. Special brands upward.

Cold Rolled Steel Shafting—Base size in carloads, about 2 5/16c.; 2¾c. for smaller quantities from store.

Copper—Carload lots, Lake Superior ingot, 10¾ @ 10 7/16c.; electrolytic, 10½ @ 10 5/8c.; casting copper, 10¼ @ 10 3/8c.

Pig Tin—For 5 and 10-ton lots, 12.85@13.00c., f.o.b.

Pig Lead—In carload lots, offered at 2.80c.

Spelter—In carload lots. New York delivery, 3.70 @ 3.75c. for various Western brands.

Antimony—Cookson's, 7@7.37½c.; Hallett's 6.37½@ 6.50c.; Japanese, 6.35 @ 6.45c.

Lard Oil—Prime city, present make, commercial quality, in carload lots, 39 @ 41c.

Manufactures.

The large addition to the Titusville Iron Works' boiler shop is about completed, ready for the installation of the new machinery.

Geo. White & Sons, London, Ont., have received a building permit to make extensive changes to their engine works on King street.

The New Castle Engineering Co. of New Castle, Pa., has been organized, to succeed the business of James P. Witherow, lately insolvent.

A new concern, the McAdams Engine Co., of San Francisco, Cal., capitalization $50,000, has been organized, with Louis C. McAdams, secretary.

The Waterbury Watch Co., Waterbury, Conn., whose factory had been closed for some time, resumed operations on Monday, Sept. 24th.

The Perfection Brewing Co., Sebewaing, Mich., will erect a large brewery; $40,000 will be expended on machinery, which will include engine, pumps, etc.

The Franklin Steel Castings Co., owing to increase of business, intend to double the capacity of their machine shop. They will install new machinery.

The Mawhinney Last Co., of Worcester, Mass., have bought a large factory at Montello, Mass., and will remove to that city. About 50 men will be employed.

Robert Miller will build a saw mill on the Northport wagon road near Rossland, B. C., about half a mile from the international line. A planing mill plant will also be added.

Geo. Turner, Patrick Clark, John A. Finch, Frank C. Loring and W. S. Norman have applied for incorporation of the British Columbia Power & Light Co., headquarters to be Rossland, B. C.

The Omer Hardwood Lumber Co., Omer, Mich., will build a mill at an expense of $80,000. Band and gang saws, improved turbines for water power, engines and pumps, etc., will be installed.

Custer Flouring Company, Custer, Mich., will erect a $120,000 flouring mill. The latest flour manufacturing machinery, turbines of improved type, engines, pumps, etc., will be installed.

Herpel Bros., of Reynoldsville, Pa., will install a small plant for electric lighting in their machine shop, and if conditions are favorable will enlarge this to furnish light elsewhere in that town.

Owing to increase of business the Geo. W. Campbell Co., of Chattanooga, Tenn., has been compelled to increase the output of their works. They will install machine tools and other machinery.

A new manufacturing company has been organized at Kansas City, Mo., for the manufacture of agricultural instruments. It is known as the Eagle Mfg. Co. H. F. Devol, of that city, is interested.

The Trenton, Mich., water works board has sold $50,000 worth of bonds to erect a new lighting and water pumping station. Electrical machinery for lighting purposes will be installed, also pumps, engines, etc.

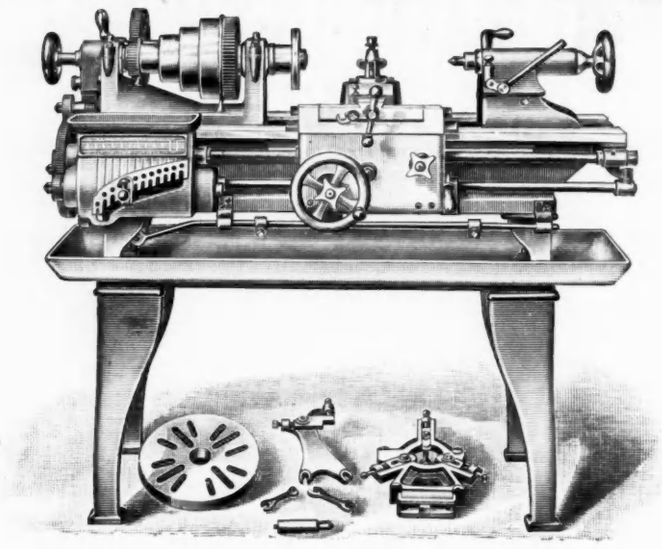
A company, under the title of the Revelstoke Water Works, Electric Light & Power Co., are seeking incorporation. W. Cowan, J. Abrahamson, W. M. Brown and T. Down are the promoters, Revelstoke, B. C.

The Richelieu & Ontario Navigation Co., of Montreal, at a recent meeting of the directors decided to at once prepare plans for two new steel boats for their service, 275 feet long, side wheelers, 22 knots per hour.

The Wisclogel Furniture Co., Muskegon, Mich., will erect a new plant and spend $35,000 for chair and table manufacturing machinery, presses, dry kilns, resawing saws, rip and cut saws, planers, matchers and molders, engines and pumps.

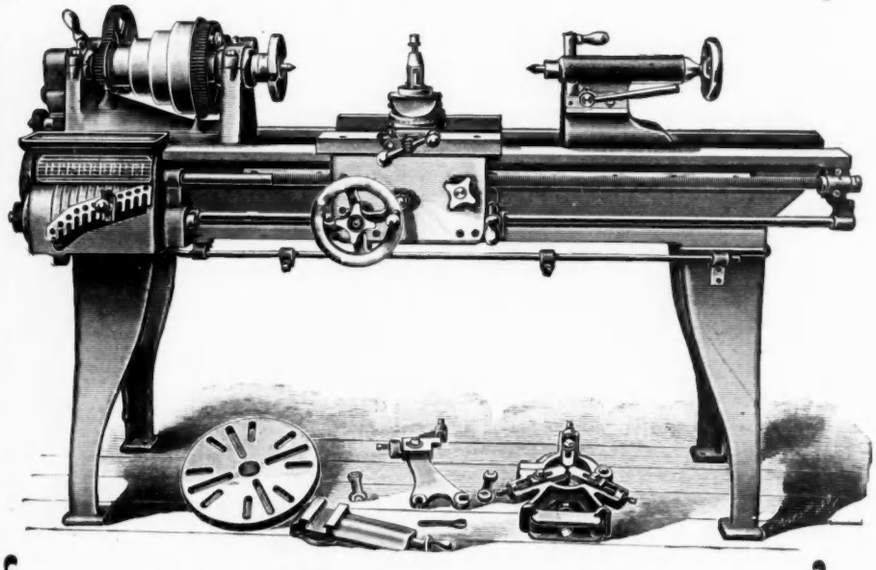
The Hildebrant Lumber Co., Corunna, Mich., will erect a large lumber mill and expend $25,000 for new machinery, which will include gang and rip saws, trimmers, steam carriages, small electric

(Continued on page 39.)



12" Hendey-Norton Lathe

is fitted with drawing-in sleeve and American Watch Tool Co's standard chuck, used in making small taps, reamers, etc. Work finished first and cut from bar afterwards. No centering required. See carriage reverse lever by right-hand side of apron; no reaching for countershaft shipper required.



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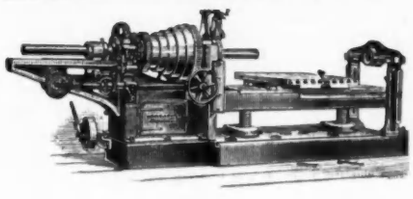

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(Continued from page 38)

light plant for lighting purposes, engines, pumps, etc.

Smalley & Woodworths Lumber Co., Bay City, Mich., will rebuild their recently destroyed saw mill. $65,000 will be expended on new machinery. Band and gang saws, trimmers, edgers, grinders, lath and shingle machinery, engines and pumps will be installed.

The Hoovey Mfg. Co., Corunna, Mich., will erect a plant for manufacturing special machinery. Draw bars, check plates, valves, gas engines and motors, dynamos, etc., special drilling, planing and polishing machines, dies, punches, engine, pumps, etc., will be installed.

The Oval Dish Co., Travers City, Mich., will build a large mill for the manufacture of all kinds of woodenware. Pail, tub, lath, shingle, stave, handle and dish manufacturing machines will be installed; also wood turning machinery, band, rip and resaw saws, engine, pumps and grinders.

Our correspondent who sent in an item about the M. C. R. R. shops at Jackson, Mich., now informs us that though he fully believed in the accuracy of the report at the time, he now finds this story about new shops was simply a bluff to carry weight in favor of the company, who were at that time trying to secure a franchise from the Jackson city council.

Brown & Sharpe Mfg. Co., Providence, R. I., announce that their business of hardening and annealing dies and other tools for manufacturing jewelers and others has grown to such magnitude as to justify the erection of a special building for that purpose, and such a building has been erected and contains every possible facility for the work.

The Mossberg Mfg. Co., of Attleboro, Mass., has been incorporated under the name of the Mossberg & Granville Mfg. Co., with a capital of $700,000. The facilities of the company will be increased, and it will erect a factory as soon as possible large enough to employ about 500 machinists. Heavy as well as light work will be built, and a department of the factory will be devoted to the construction of the Mossberg roller bearings.

A new concern, known as the Air-Pressure Cylinder Co., of New York City, has recently been incorporated for the purpose of manufacturing material and appliances for the transmission of gas, air, etc. The new company has a capital of $1,000,000, and the following gentlemen are the directors: Charles E. Warren, of Noroton, Conn.; Henry A. Robinson, of Yonkers; John T. Little, Jr., and Henry L. Stimson, of New York City; George E. B. Howard, of South Orange, N. J.; Michael Sandford, of Hackensack, N. J., and William B. Dorman, of Brooklyn, N. Y.

The following new companies have been gazetted in British Columbia: Badger-Tourmaline Consolidated Gold Mining Co.; objects, general mining; capital, $1,500,000; first trustees, R F. Dodd, John Lineham and H. Walters; chief place of business, Rossland, B. C. British Columbia Consolidated Gold Mining Co.; capital, $1,000,000; first trustees, J. H. Adams, D. Campbell, C. M. Carpenter, Chas. Grant, Robert Hunter and H. M. Lister; chief office, Rossland, B. C. Consolidated Sable Creek Mining Co.; capital, $1,500,000; trustees, F. Coper, R. E. McKechnie and G. D. Scott; head office, Vancouver, B. C. Delacola Gold Mining Co.; capital, $1,000,000; trustees, John Donahoe, Geo. Hering, E. W. Johnson, G. W. Meyers and Ross Thompson; headquarters, Rossland, B. C. Lardean Mining & Development Co.; capital, $500,000; trustees, John Abrahamson, E. L. Kinman and F. B. Wells; head office, Revelstoke, B. C. Kootenay Consolidated Mining Co.; capital, $1,000,000; head office, Washington, D. C., U. S. A. Mount Mabel Mining & Smelting Co.; capital, $1,500,000; trustees, M. A. St. C. Brindle, A. R. Code and A. J. Hughes; head office, New Denver, B. C. Standard Gold Mining Co.; objects, general mining; capital, $1,000,000; trustees, F. R. Blochberger, H. Heffering, F. S. Timberlake and S. E. Timberlake; head office, Vancouver, B. C. Yale Gold Copper Mining Co.; capital, $1,000,000; trustees, T. C. Gray, Geo. Talbot and E. W. Terzick; head office, Rossland, B. C.

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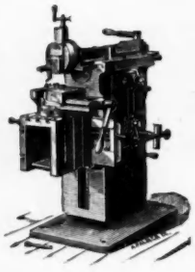

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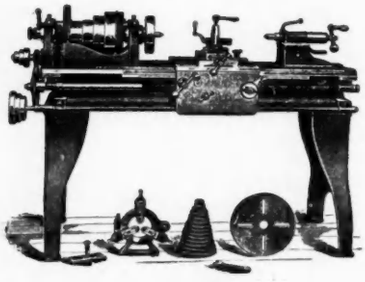

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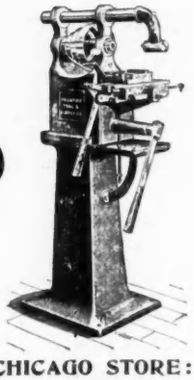

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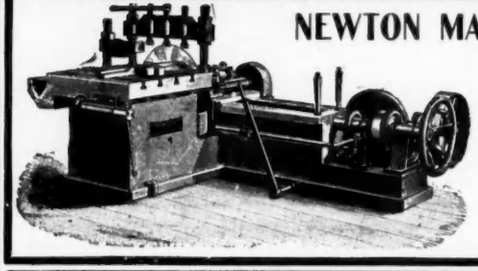

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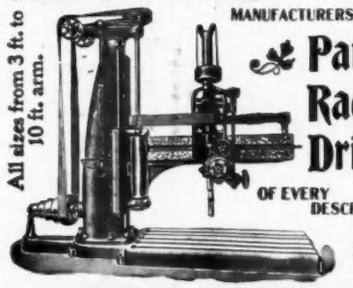

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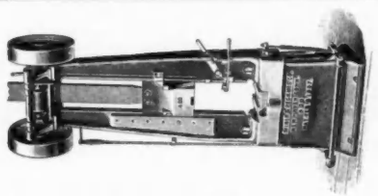

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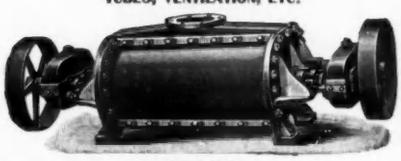

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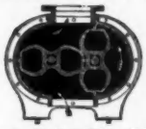

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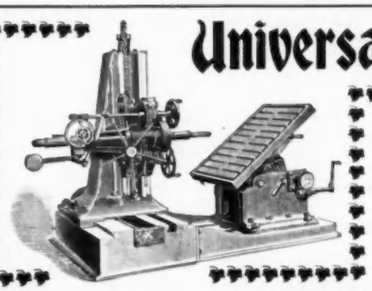

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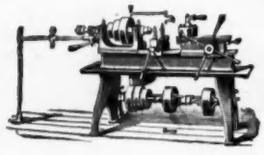

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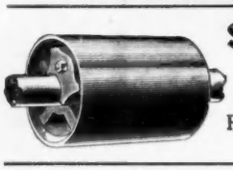

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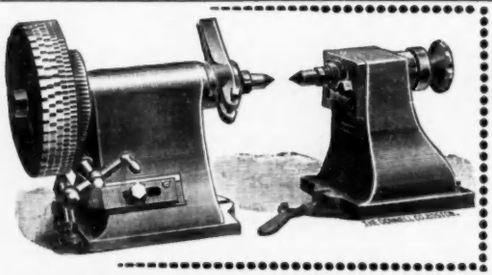

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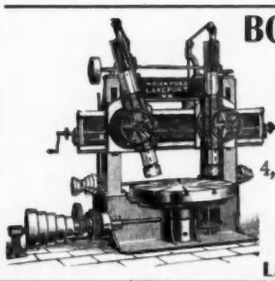

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